

MARS15 Modeling of Machine-Induced Backgrounds

V. Alexakhin, Fermilab

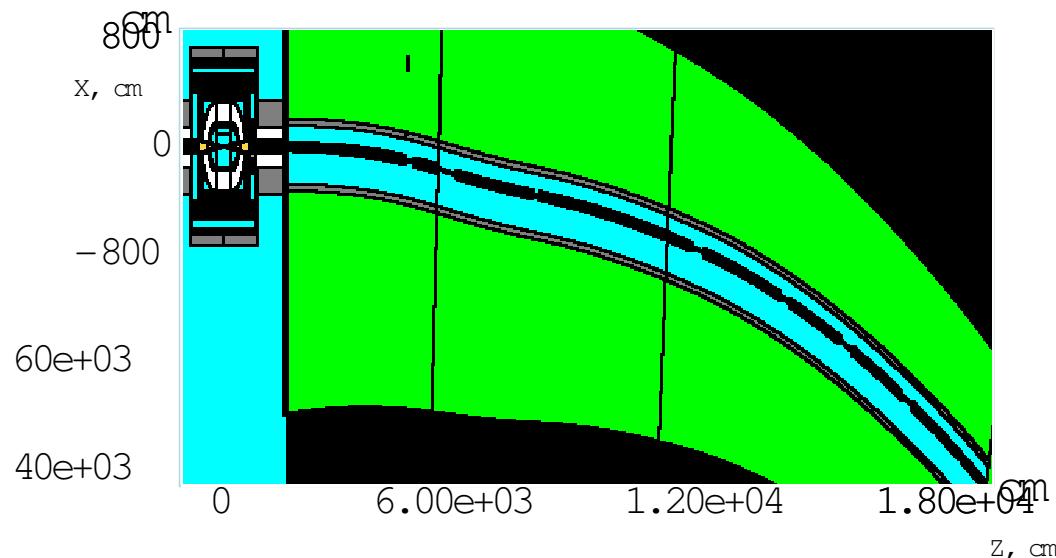
Muon Collider Physics Workshop
Fermilab Nov 10–12 2009

Beam line lattice

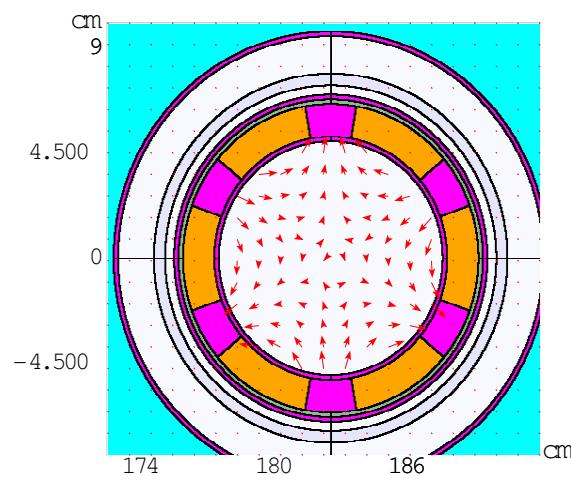
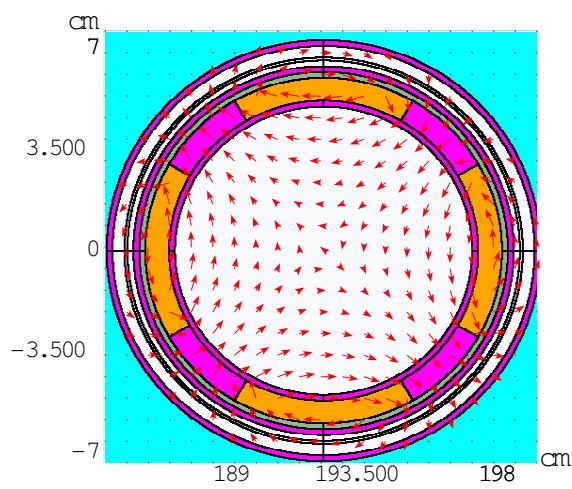
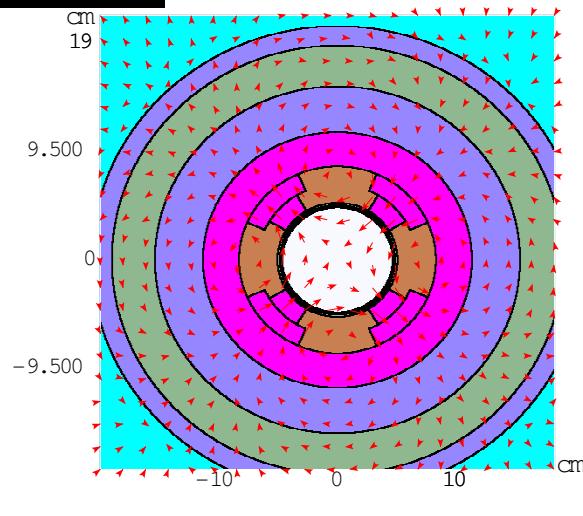
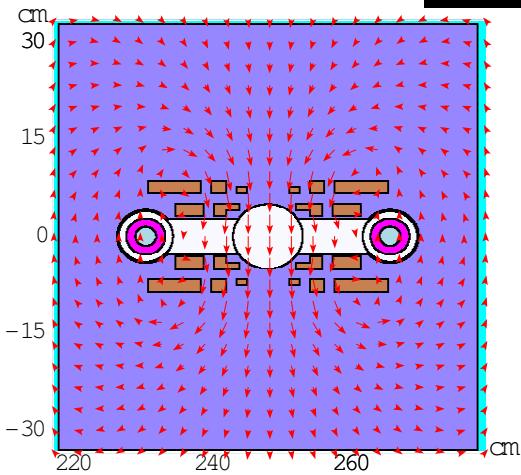
MAD8 “OPTICS” file as input. 2x750GeV MC, “n-1” version.
Region of interest is up to 180m far from the IP.

KEYWORD	TYPE	NAME	S(m)	L(m)	KOL	K1L	...

"MARKER"	"~"	"IP"	0.000	0.00	0.00000	0.00000	
"DRIFT"	"DRIFT"	"DR1"	6.000	6.00	0.00000	0.00000	
"QUADRUPOLE"	"QNB3_7"	"QLB1"	7.500	1.50	0.00000	0.150000	
"DRIFT"	"DRIFT"	"DRSH"	7.800	0.30	0.00000	0.00000	
"RBEND"	"OMD_15"	"BE1"	22.45	6.00	0.192000E-01	0.00000...	

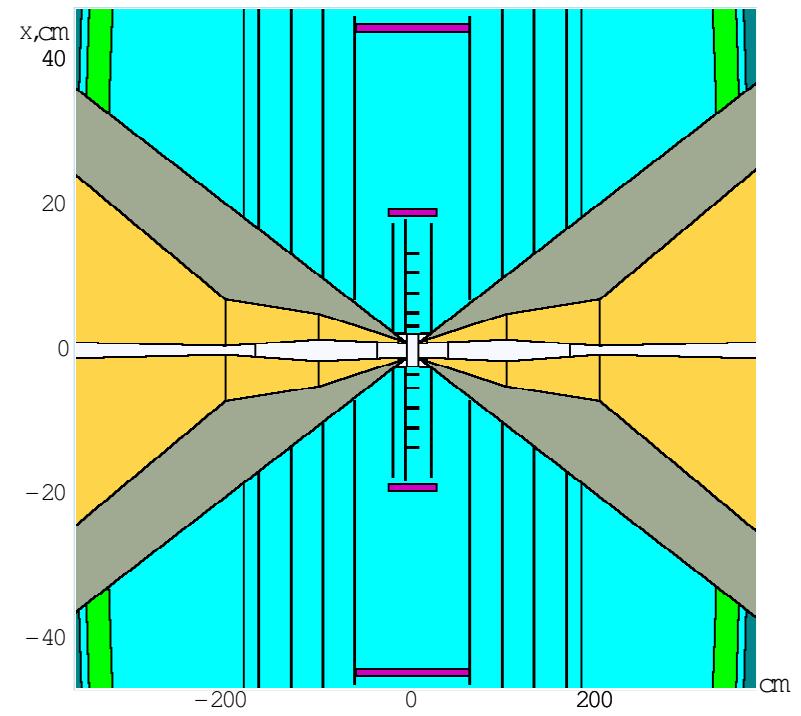
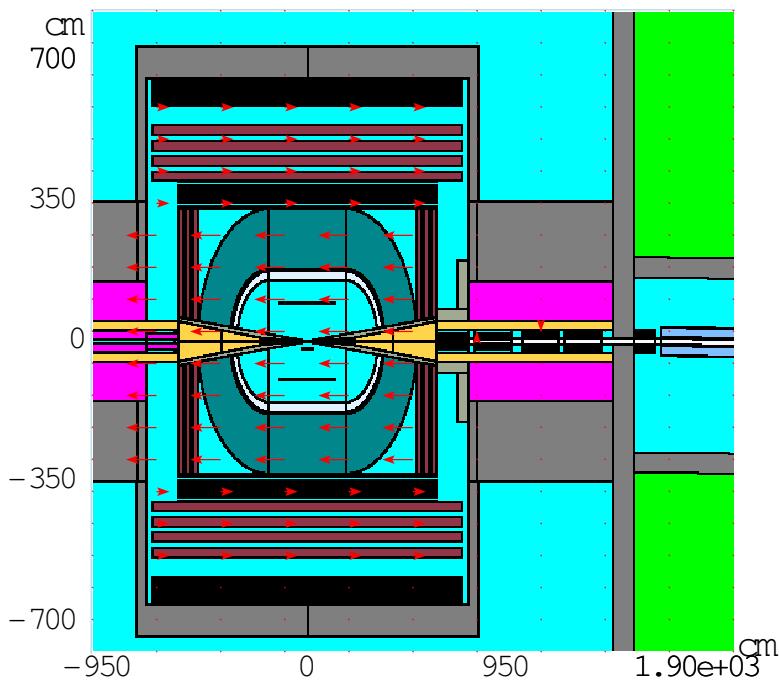


Magnets



Mumu detector and its shielding

Combined tungsten and BCH_2 shielding added. Shielding covers angles less than 6 deg, and partially present up to 10deg.

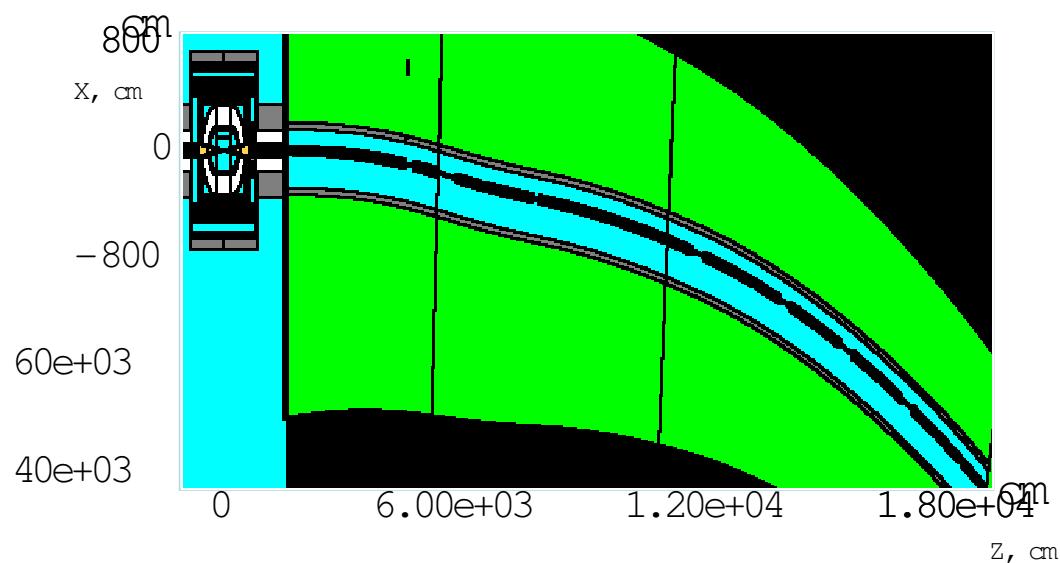


Modeling and normalization

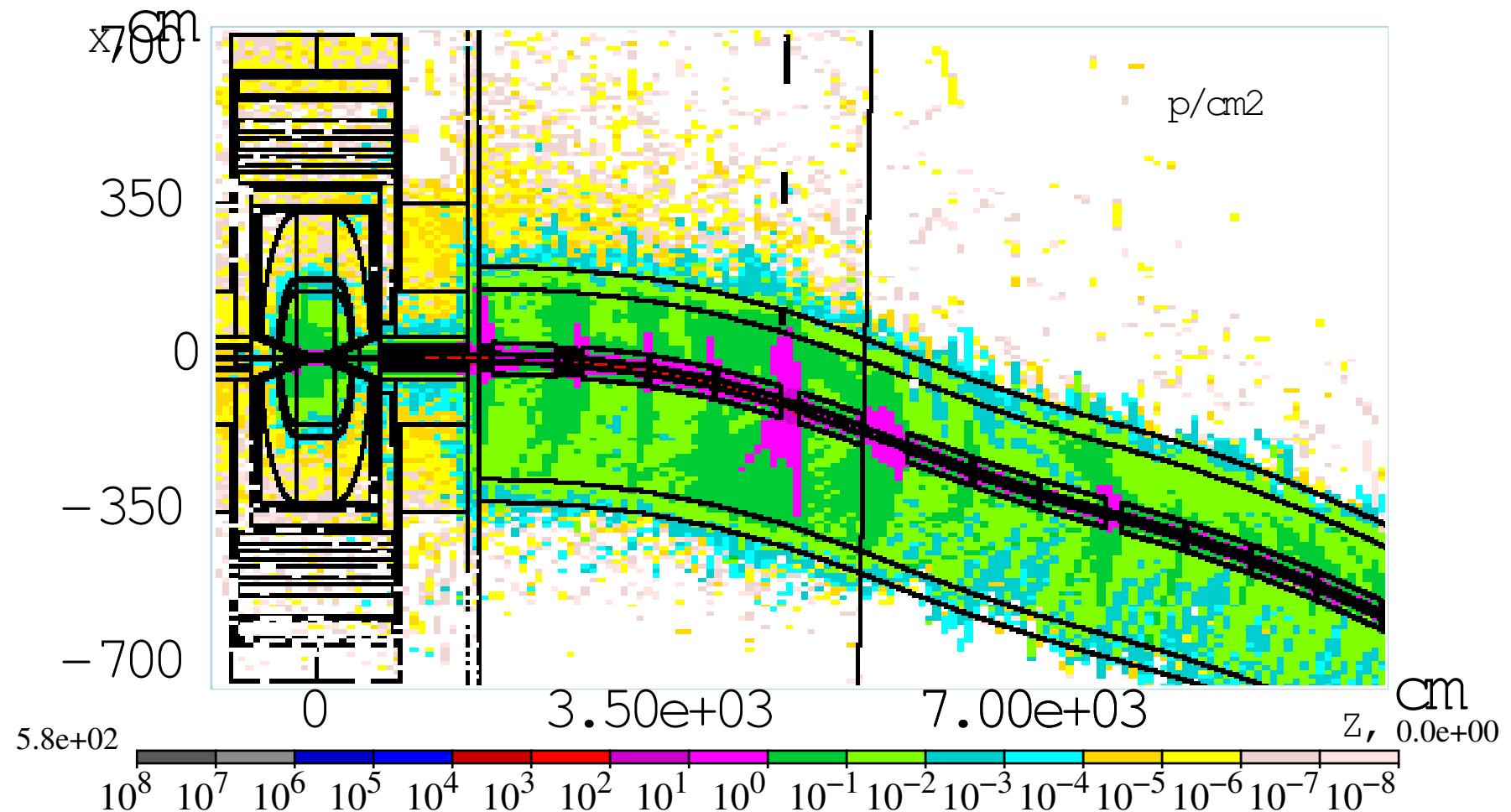
- Muon decays simulated uniformly on a Decay Range from IP to 150m upstream. Muon beam itself is simulated only virtually, parameters are taken from the TWISS table for each randomly chosen decay point along the beamline, such virtual muon is decayed immediately, without tracking. Only decay electrons are sent to the setup.
- Mean electron lab energy is 266GeV (beam energy is 750GeV), mean $\langle P_T \rangle = 30\text{MeV}/c$. Typical number of decays simulated $N_{decsim} = N * 10^7$.
- For normalization decay weight is used. The aim is to have a correct number of muon decays per bunch crossing. For 750Gev/c muon beam and $2 * 10^{12} \mu/\text{bunch}$ the number of decays is $N_d = 4.28 * 10^5 / m/\text{bunch}$. Each decay electron obtain an initial weight $W_{in} = \text{DecayRange}(m)$ and $W = W_{in} * W_{MARS} * N_d / N_{decsim}$ is used for historgam normalisation. Also note that MARS is changing weights (W_{MARS} part) for electron interaction products, etc.

Energy thresholds in zones

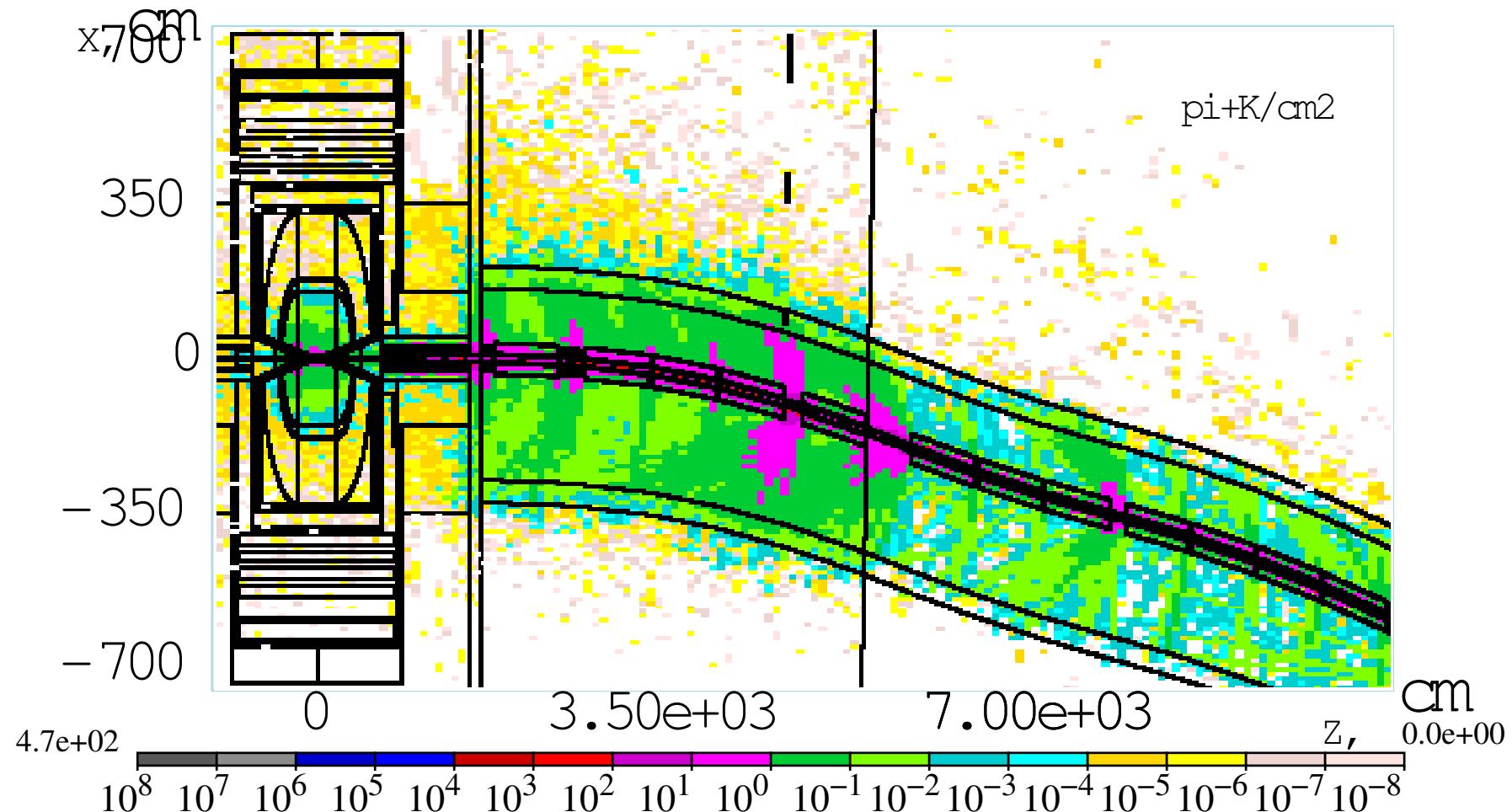
Zone	ECH(GeV)	ECN(GeV)	ECG(GeV)	ECE(GeV)
Detector($z < 15\text{m}$)	1.0E-03	1.0E-12	2.0E-04	2.0E-04
BL I($z < 50\text{m}$)	3.0E-01	2.0E-02	2.0E-02	3.0E-01
BL II($z > 50\text{m}$)	1.	3.0E-01	3.0E-01	1.0
BL III($z > 100\text{m}$)	2.	1.	1.	2.



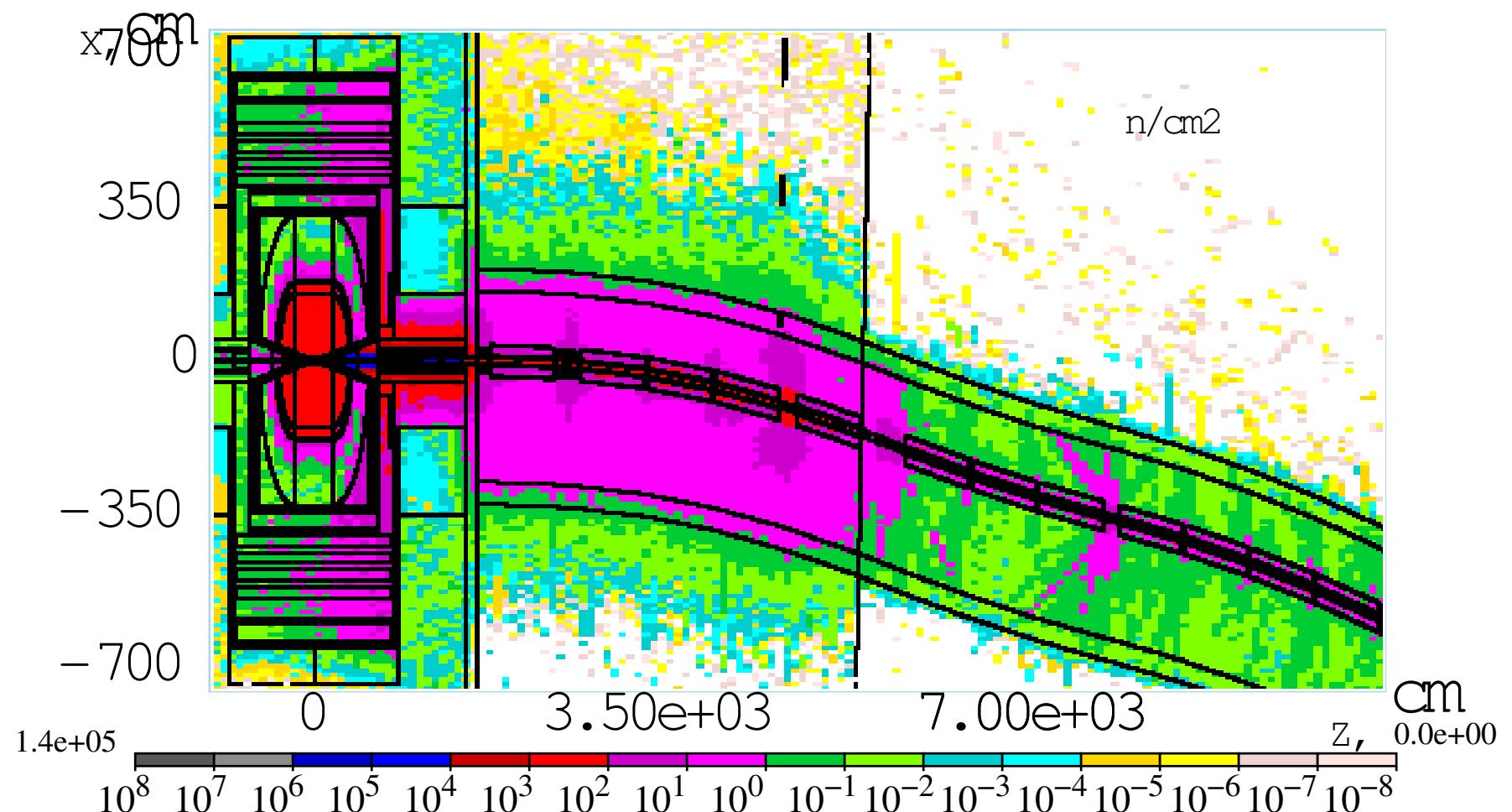
Proton fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



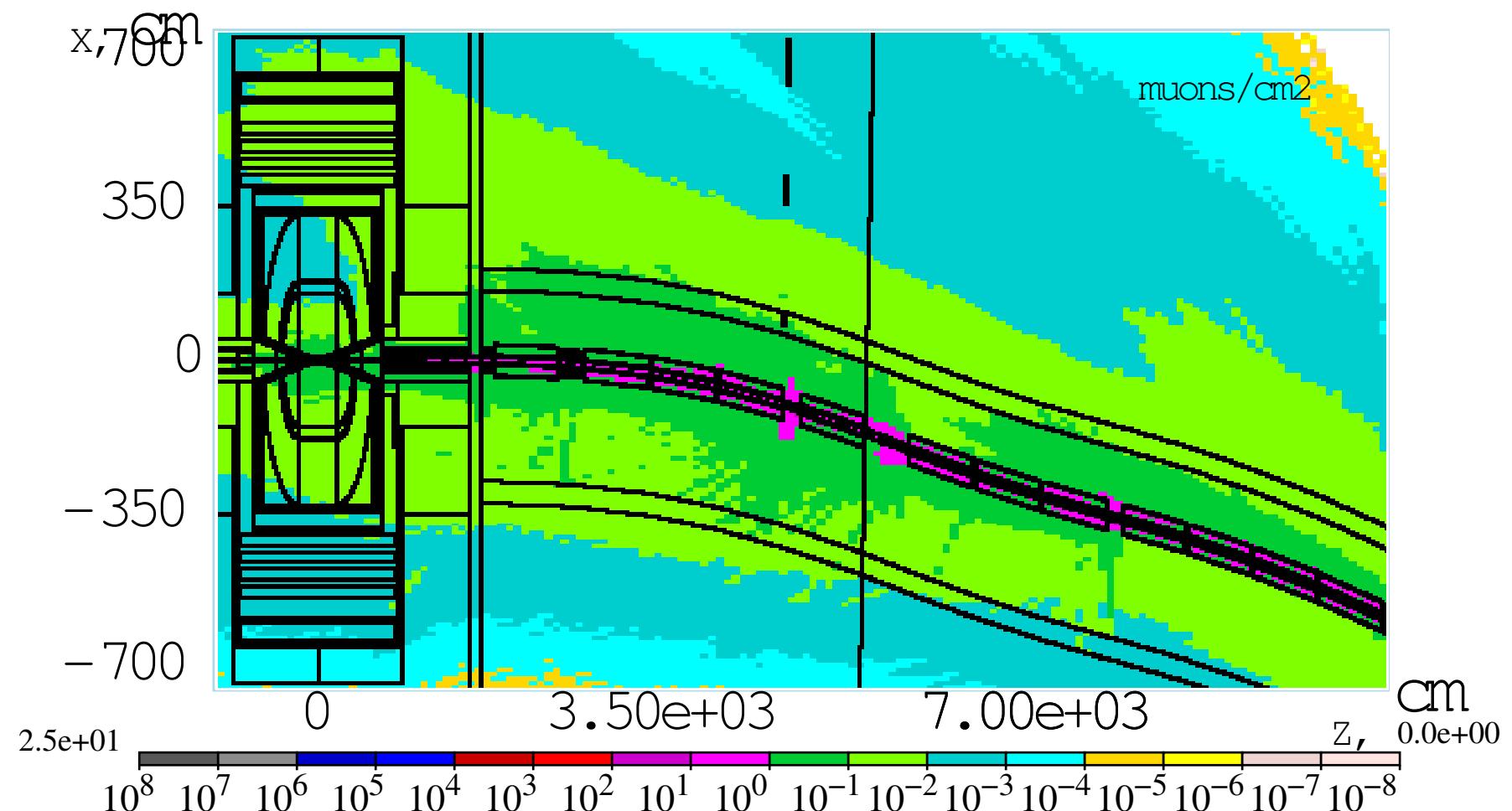
Pion and kaon fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



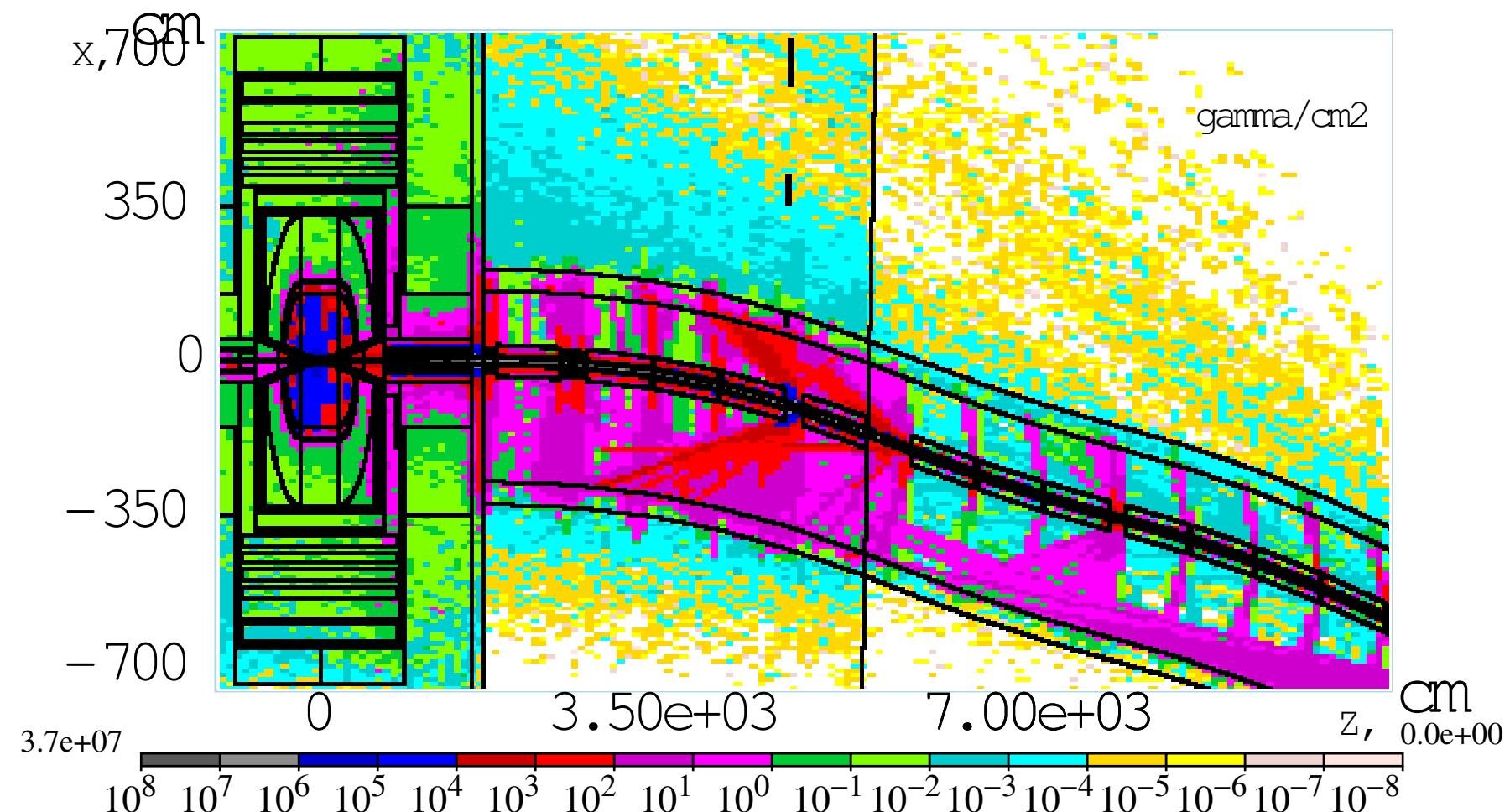
Neutron fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



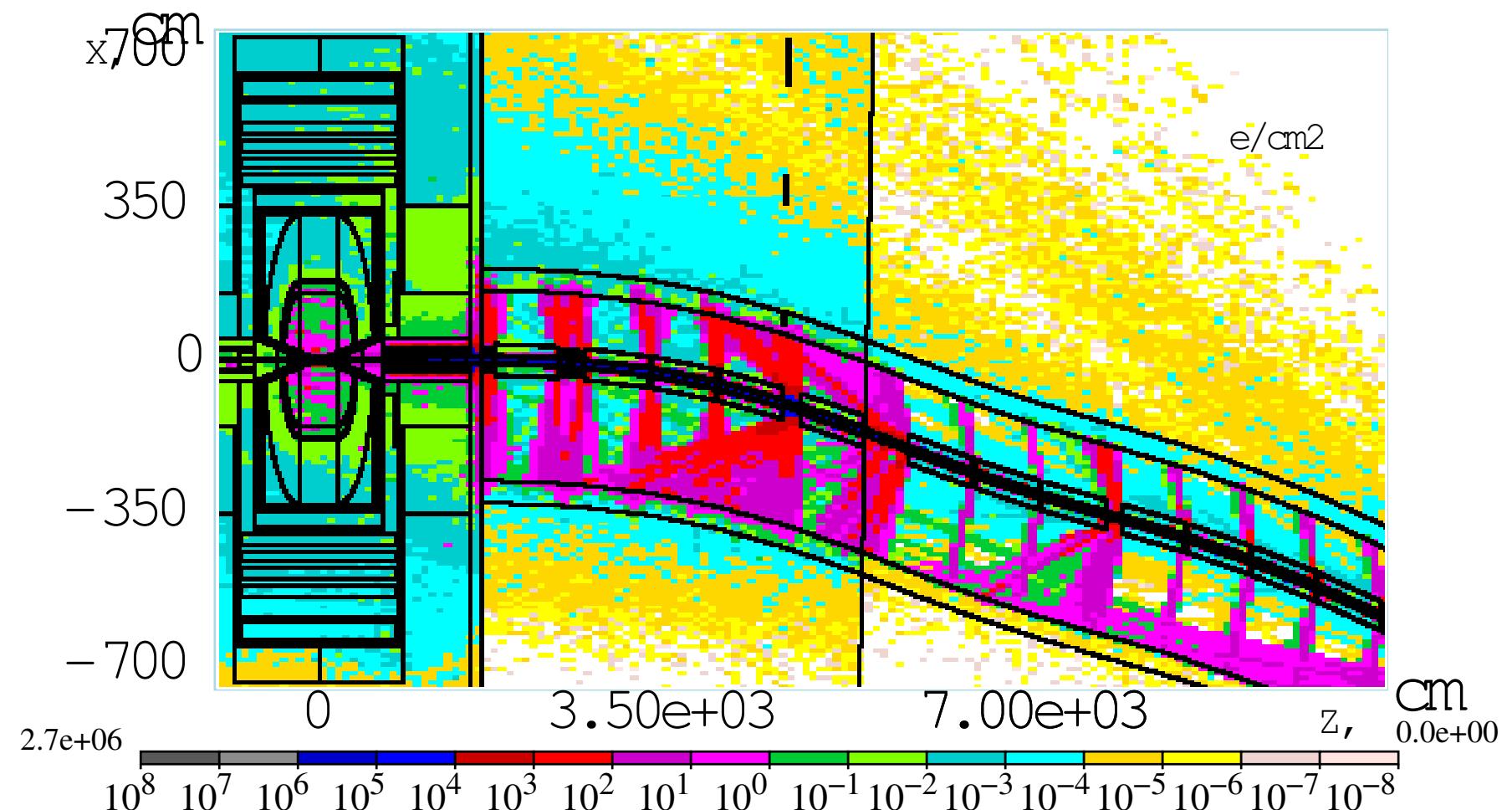
Muon fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



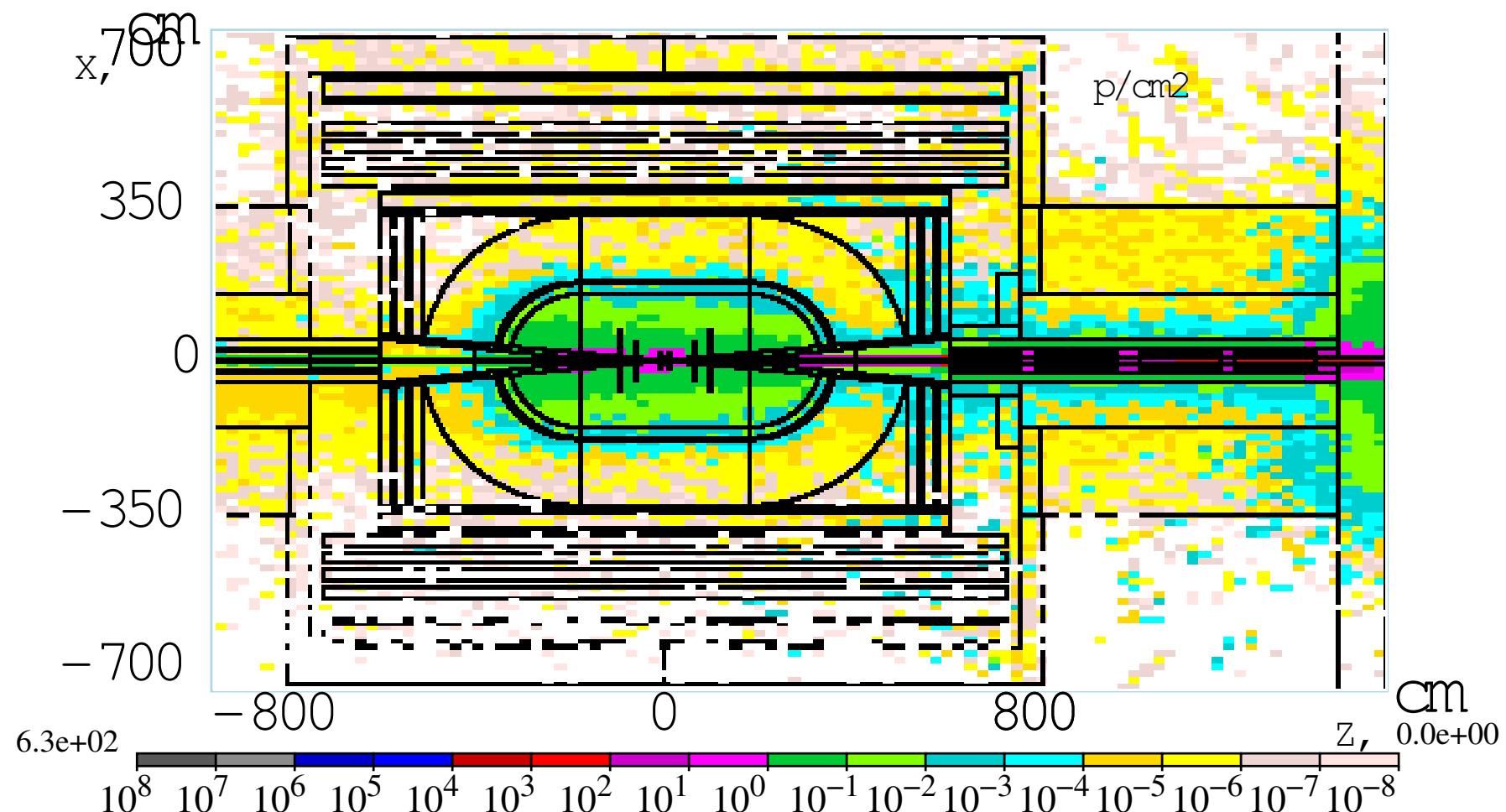
Gamma fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



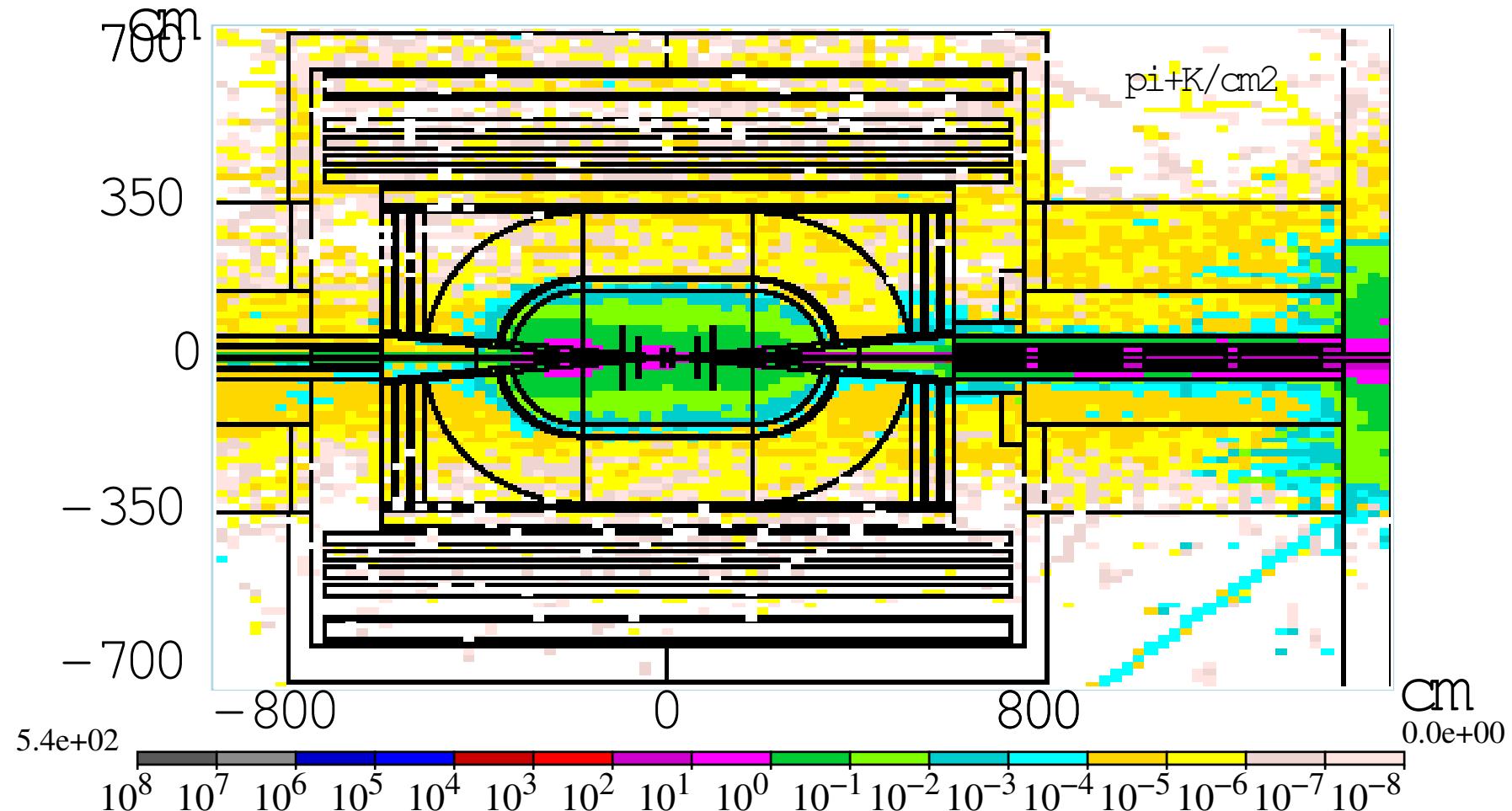
Electron fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



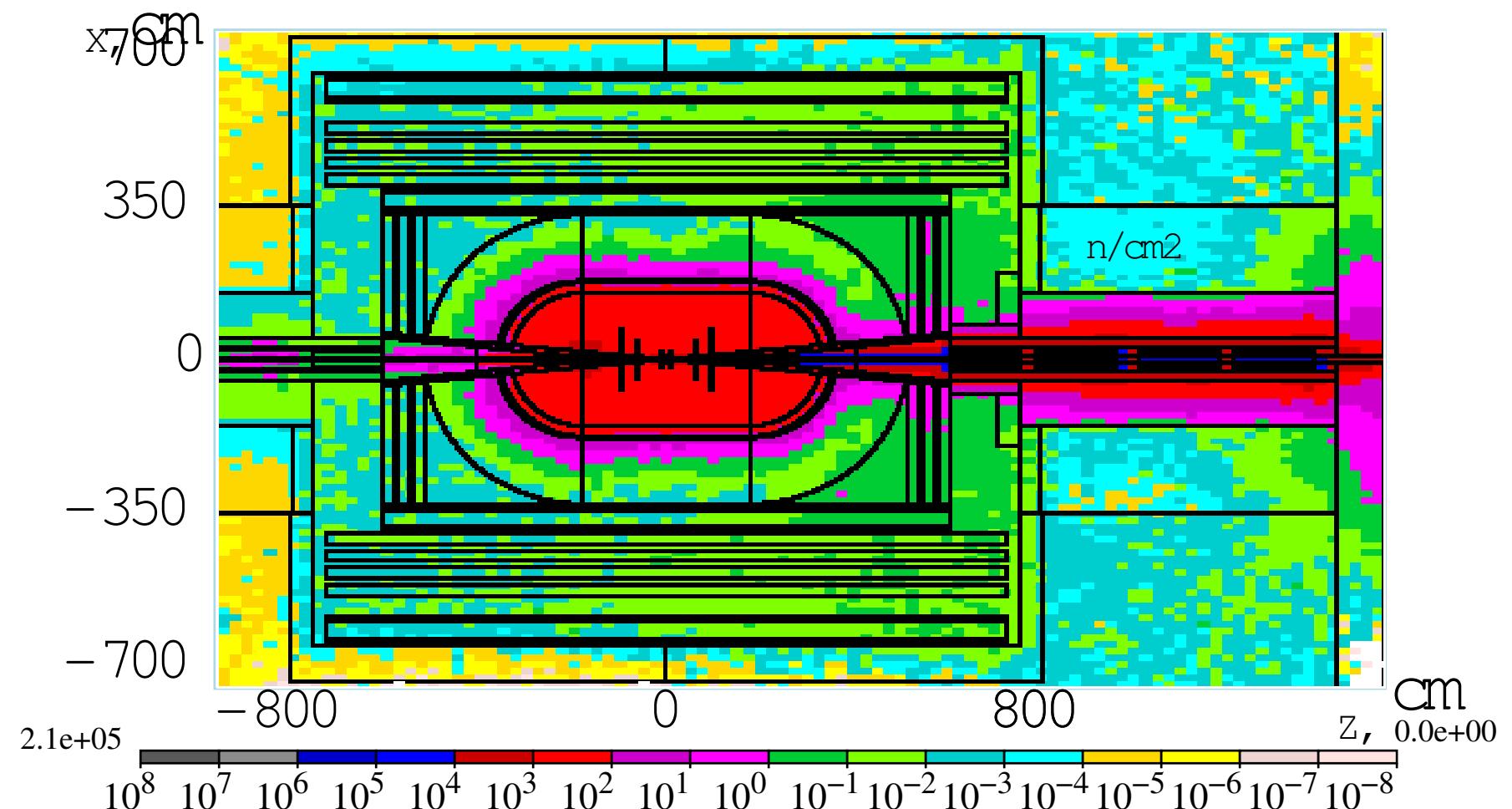
Proton fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



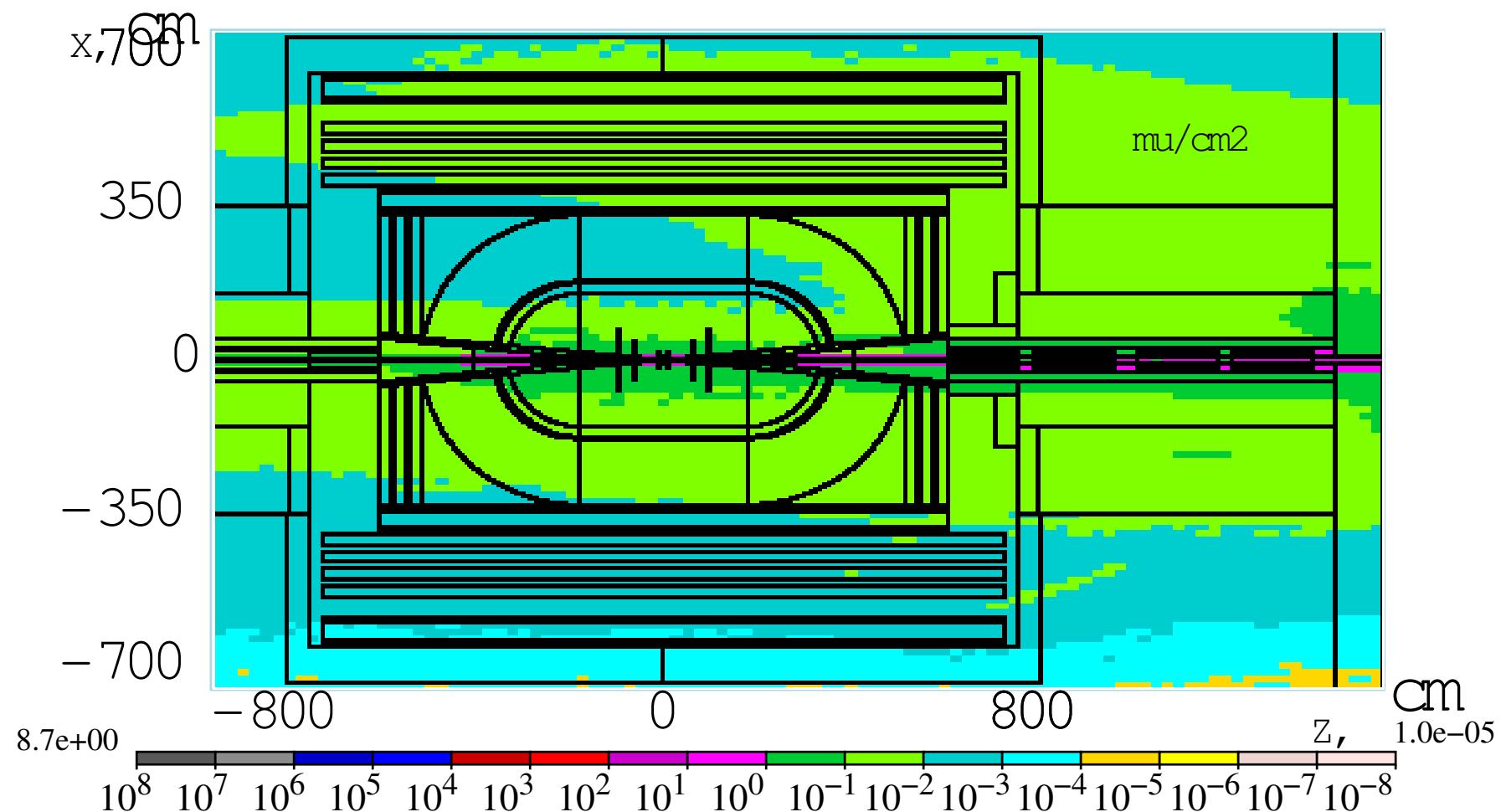
Pion and kaon fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



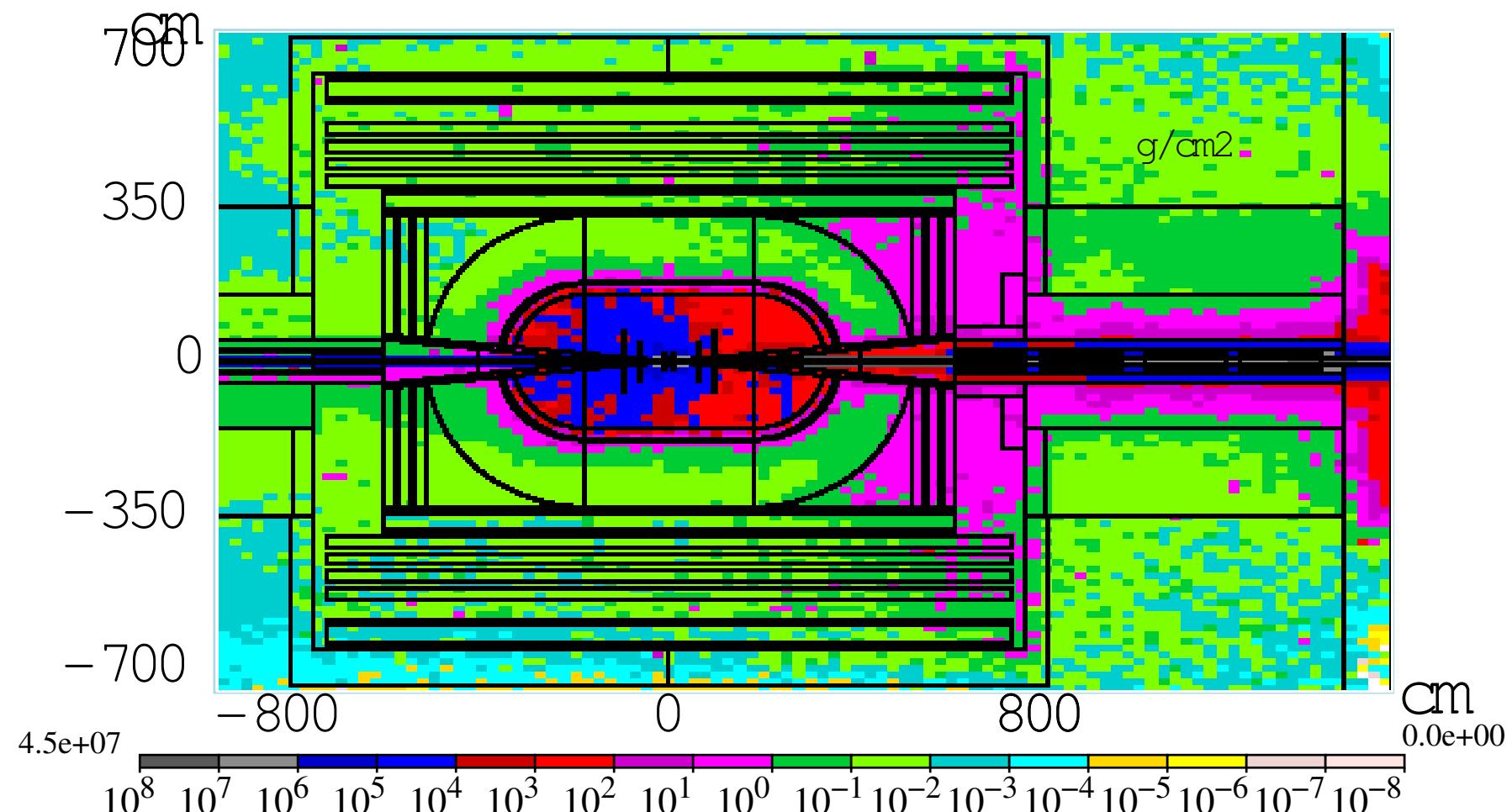
Neutron fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



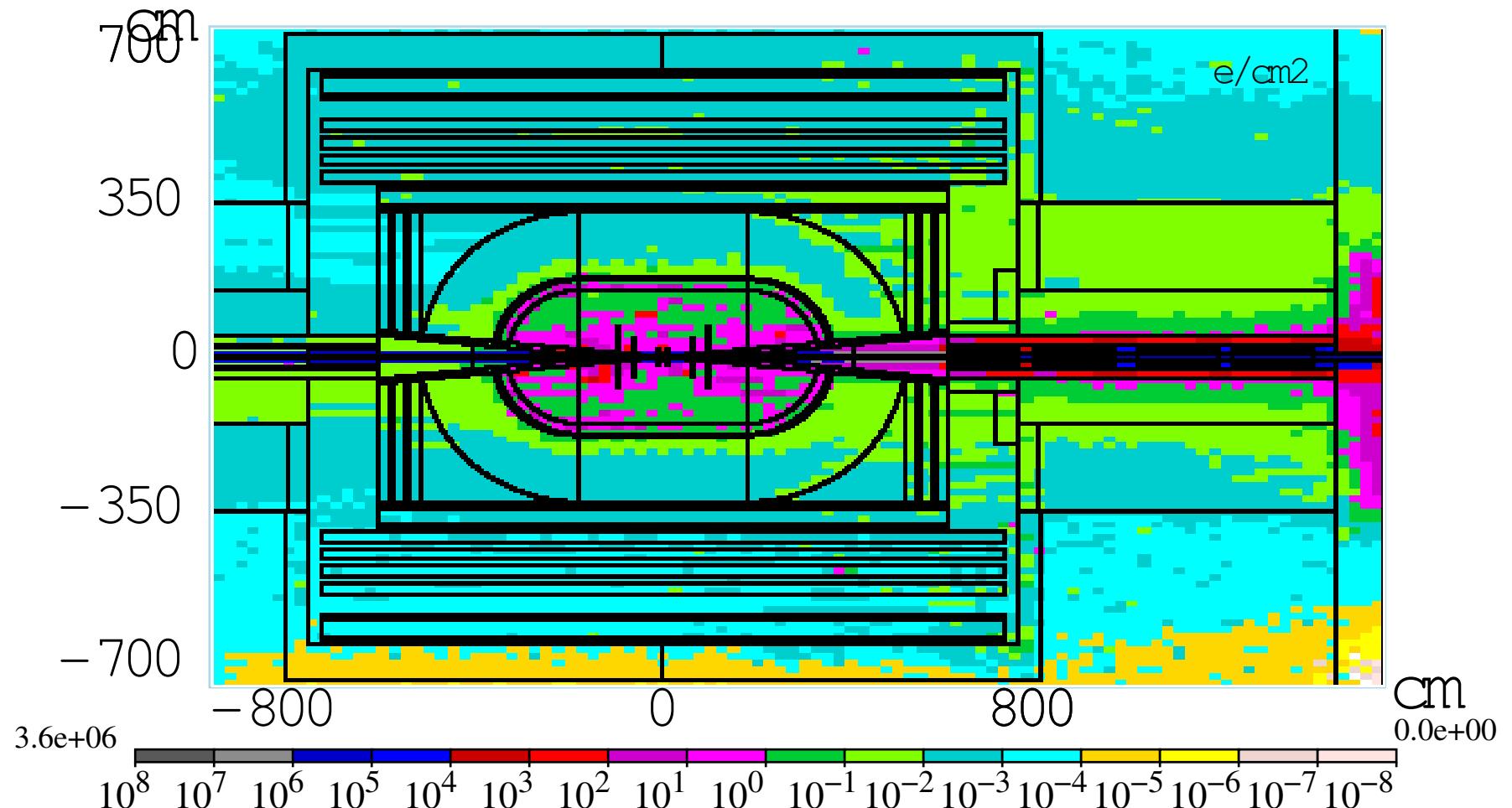
Muon fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



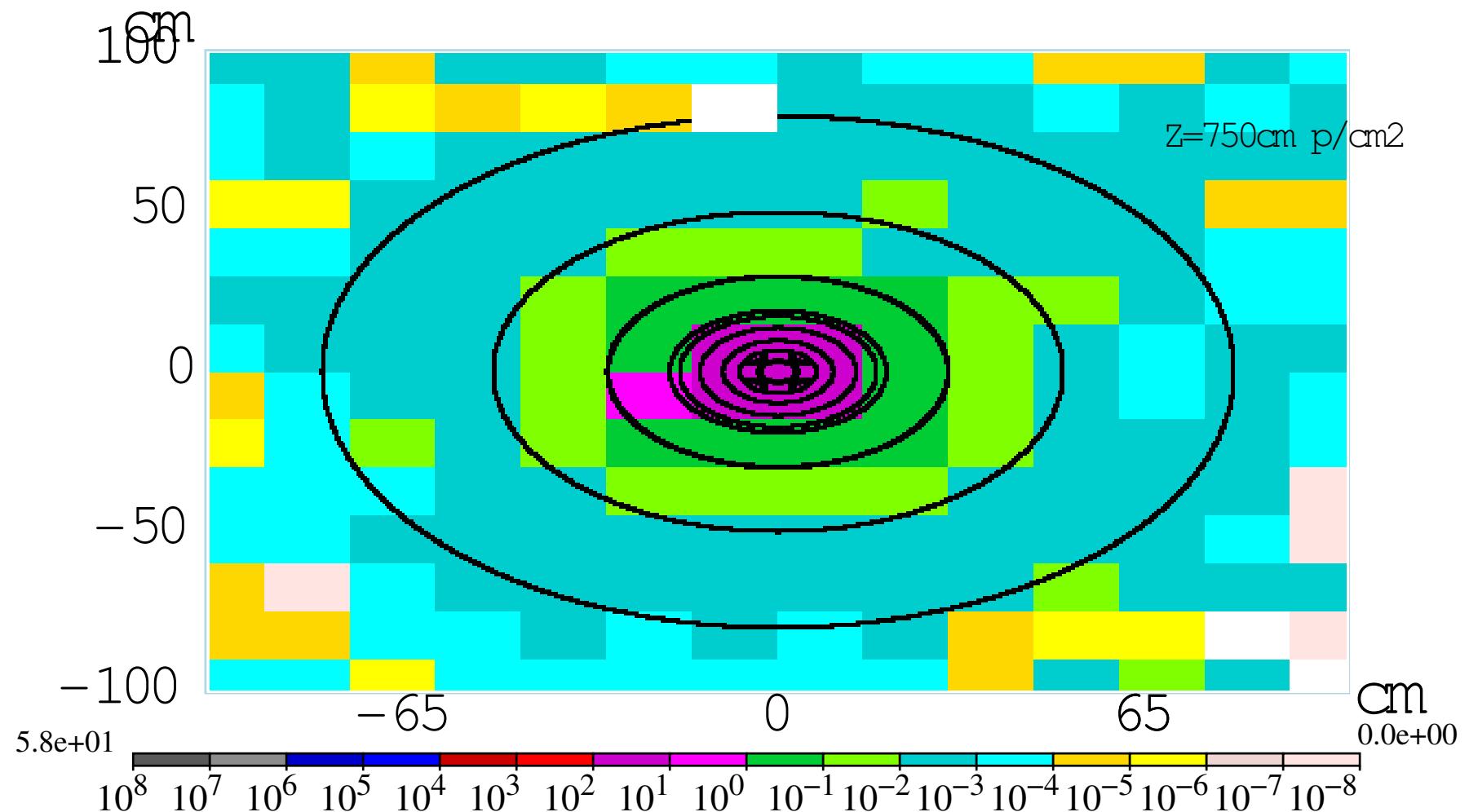
Gamma fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



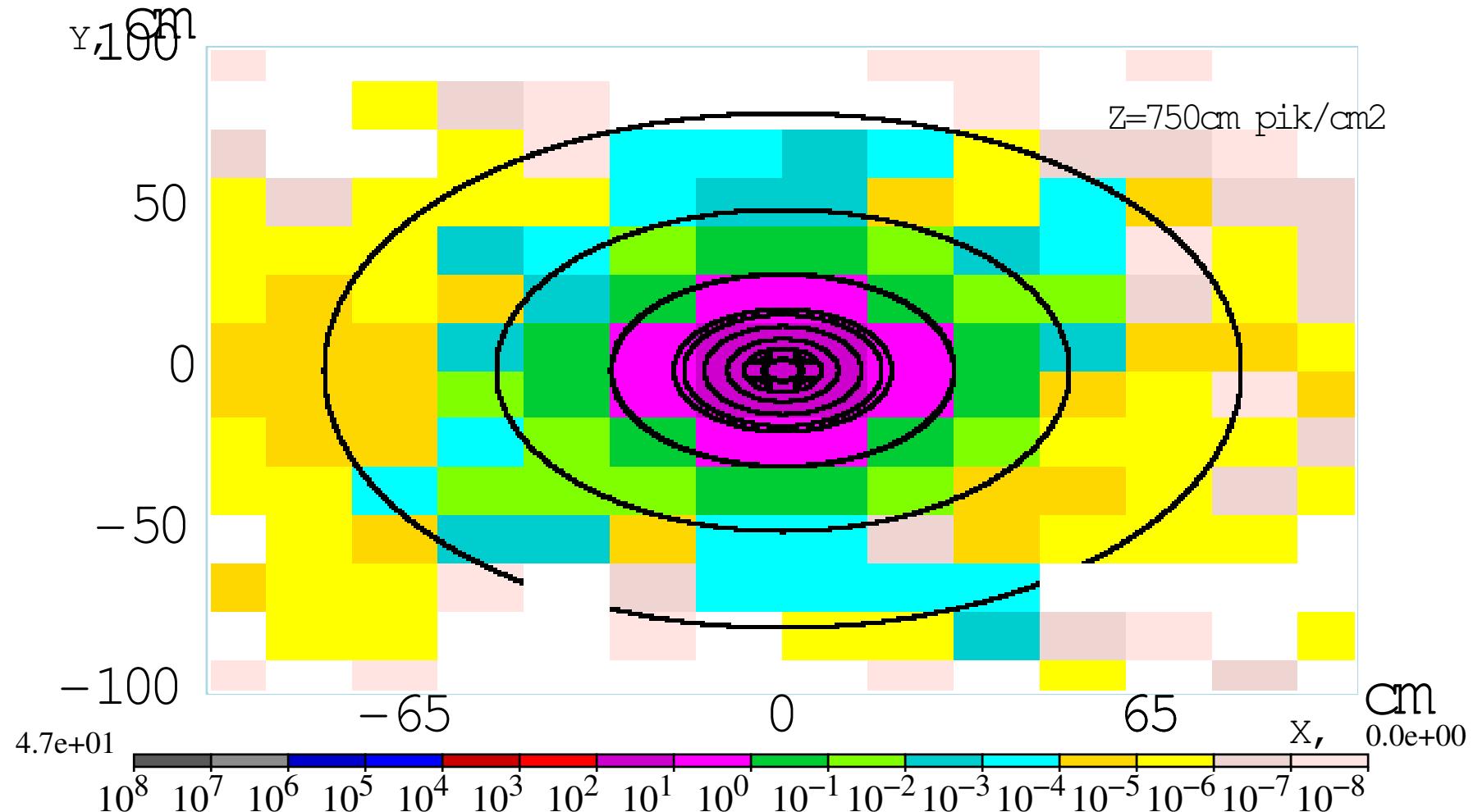
Electron fluence/cm²/bunch X-Z plane, |Y| < 2.5cm



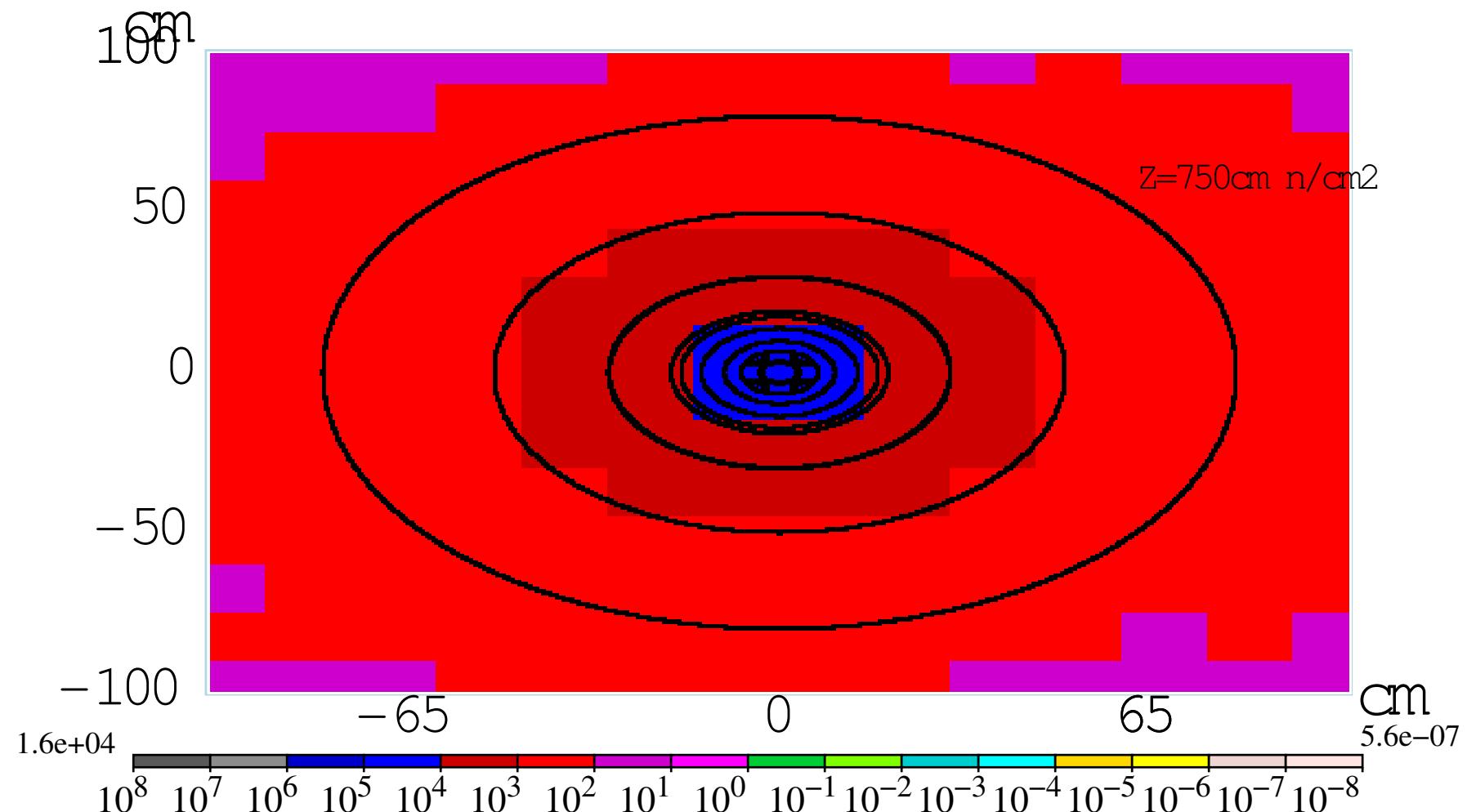
Proton fluence/cm²/bunch X-Y plane, Z = 750cm



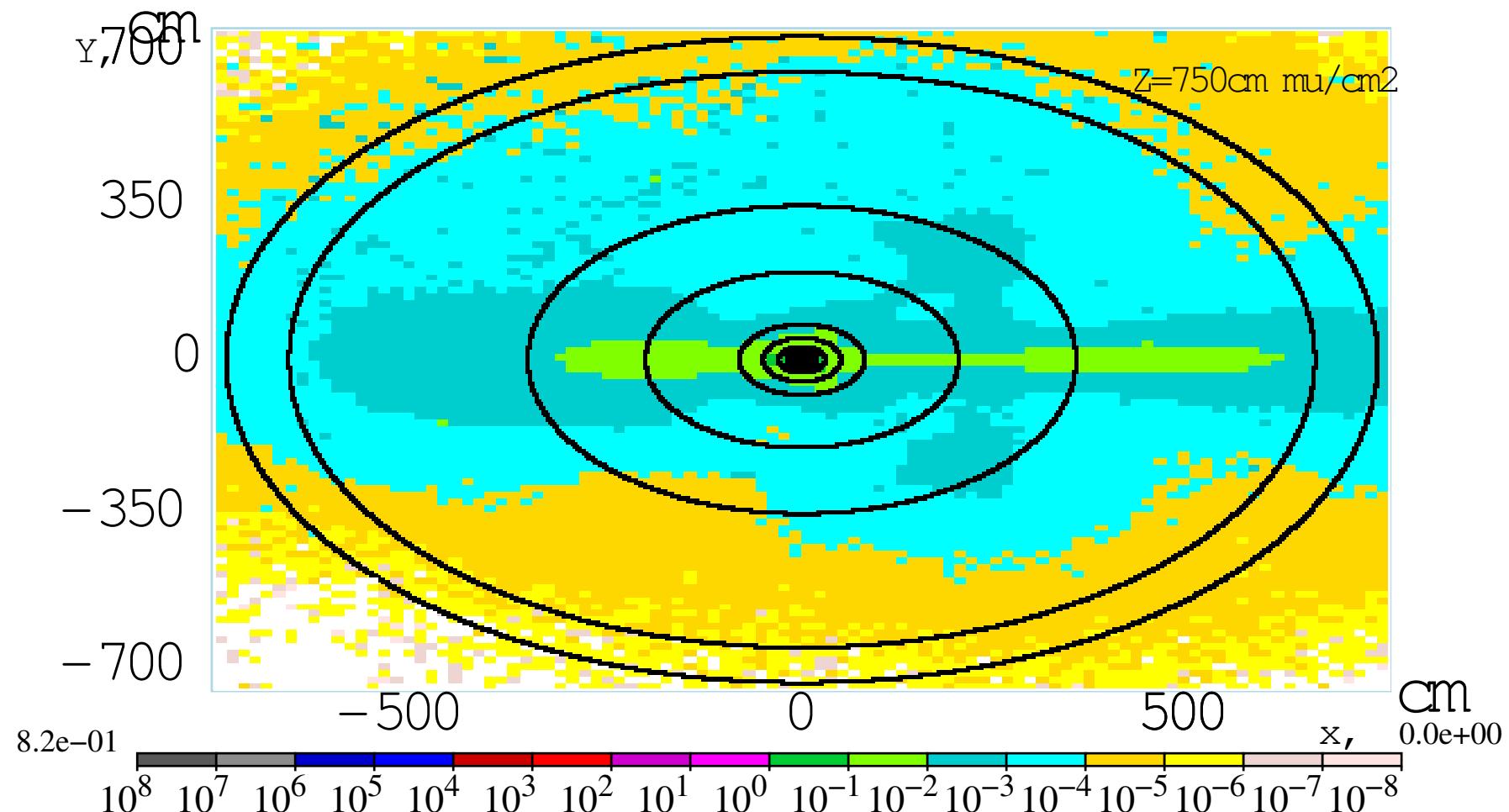
Pion and kaon fluence/cm²/bunch X-Y plane, Z = 750cm



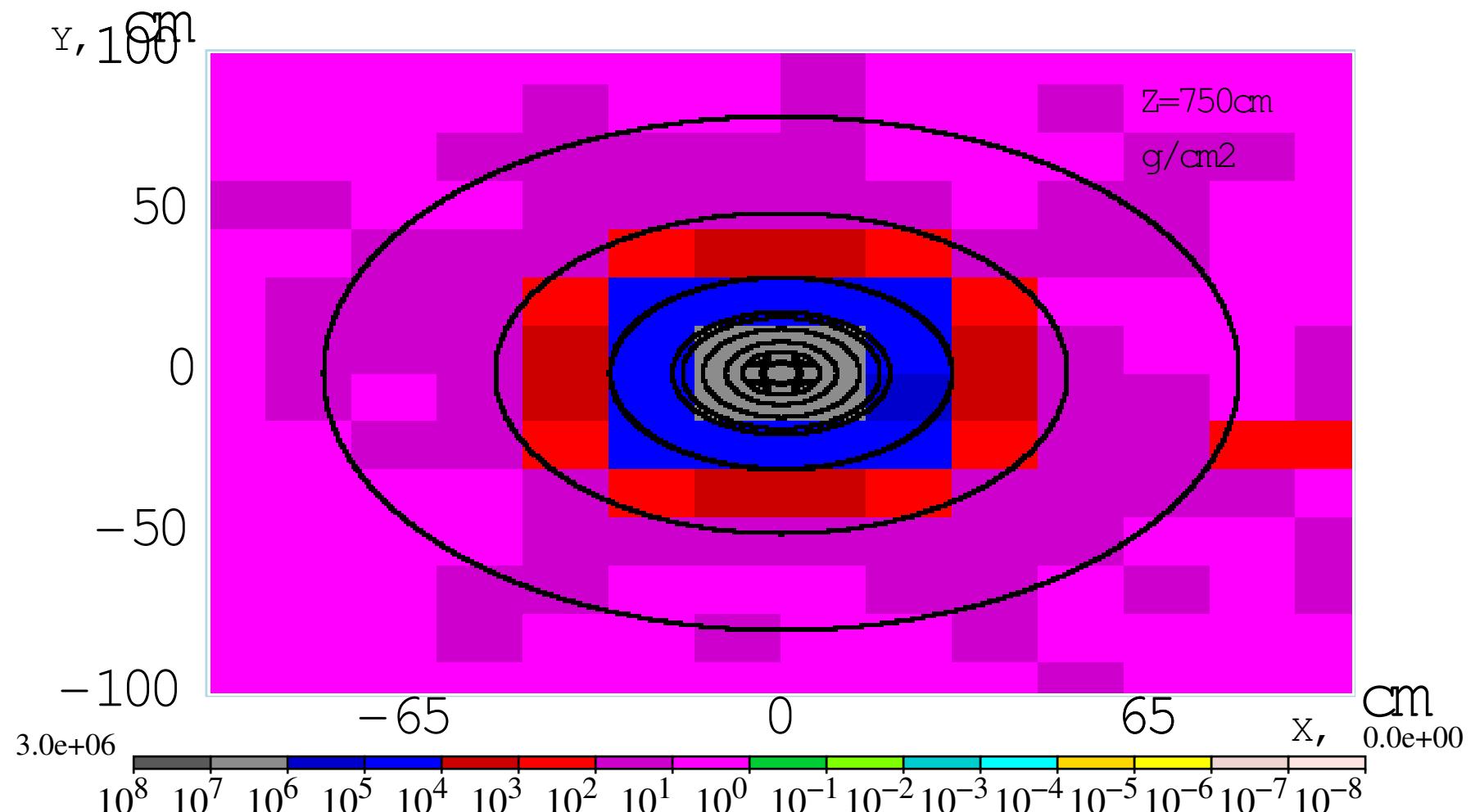
Neutron fluence/cm²/bunch X-Y plane, Z = 750cm



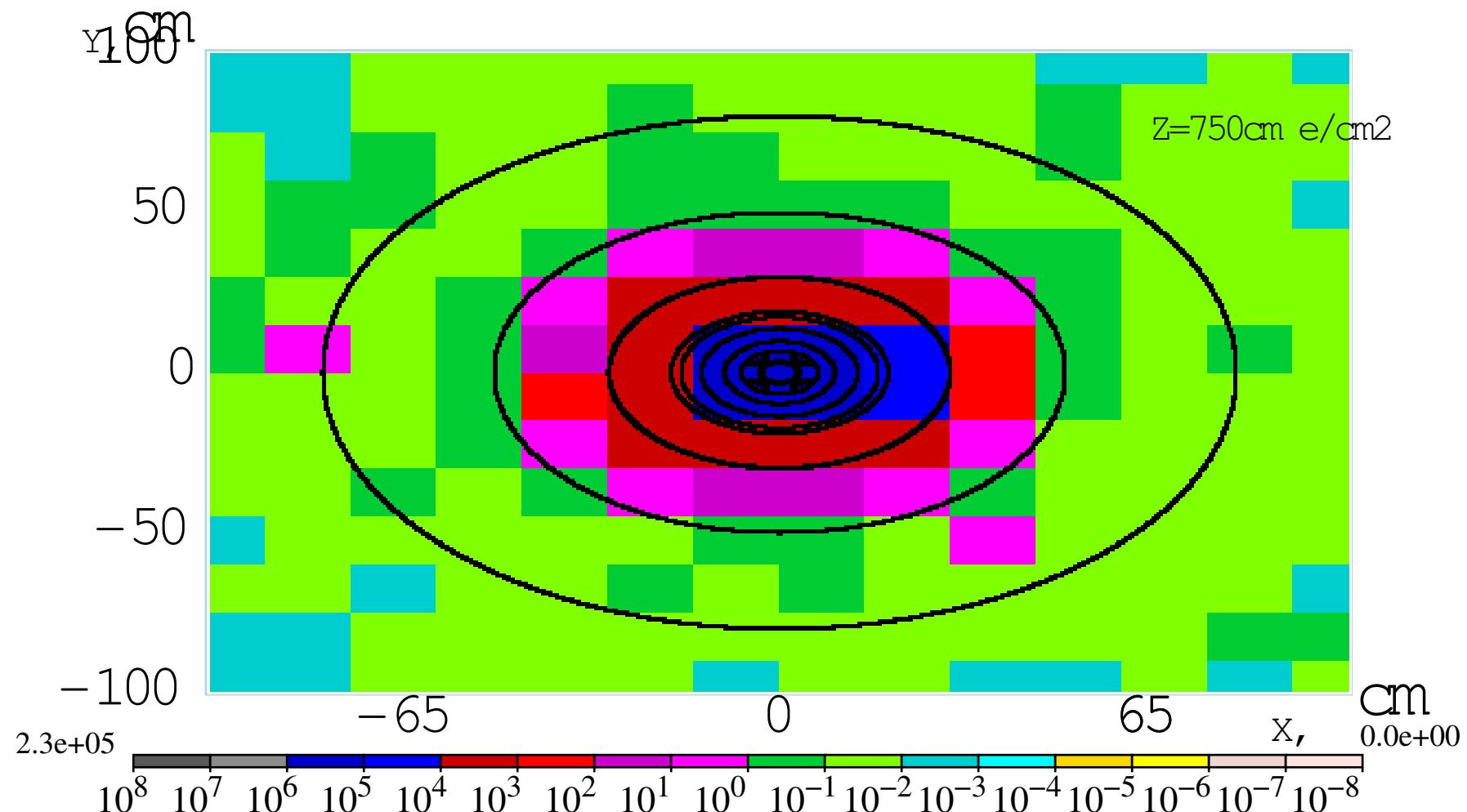
Muon fluence/cm²/bunch X-Y plane, Z = 750cm



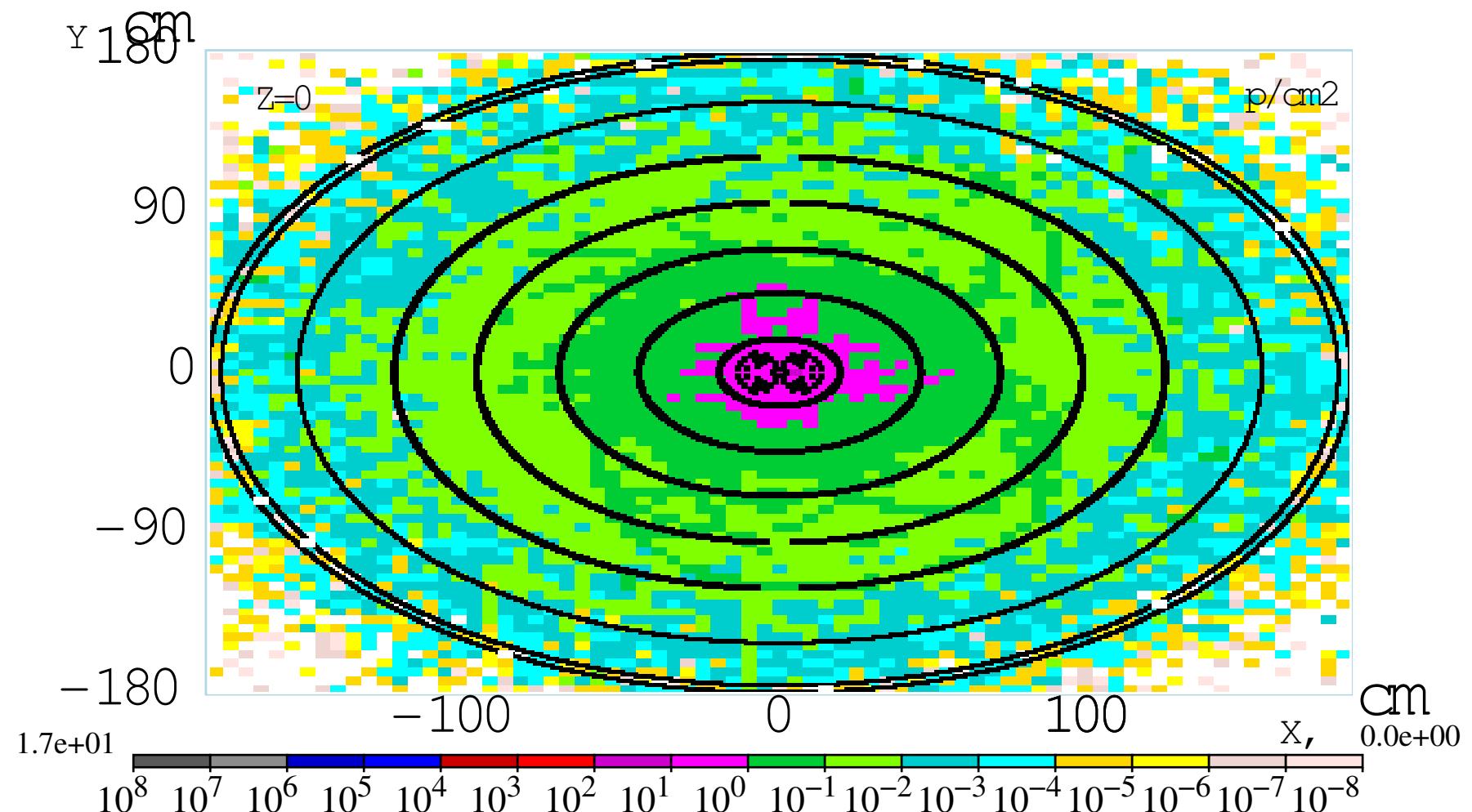
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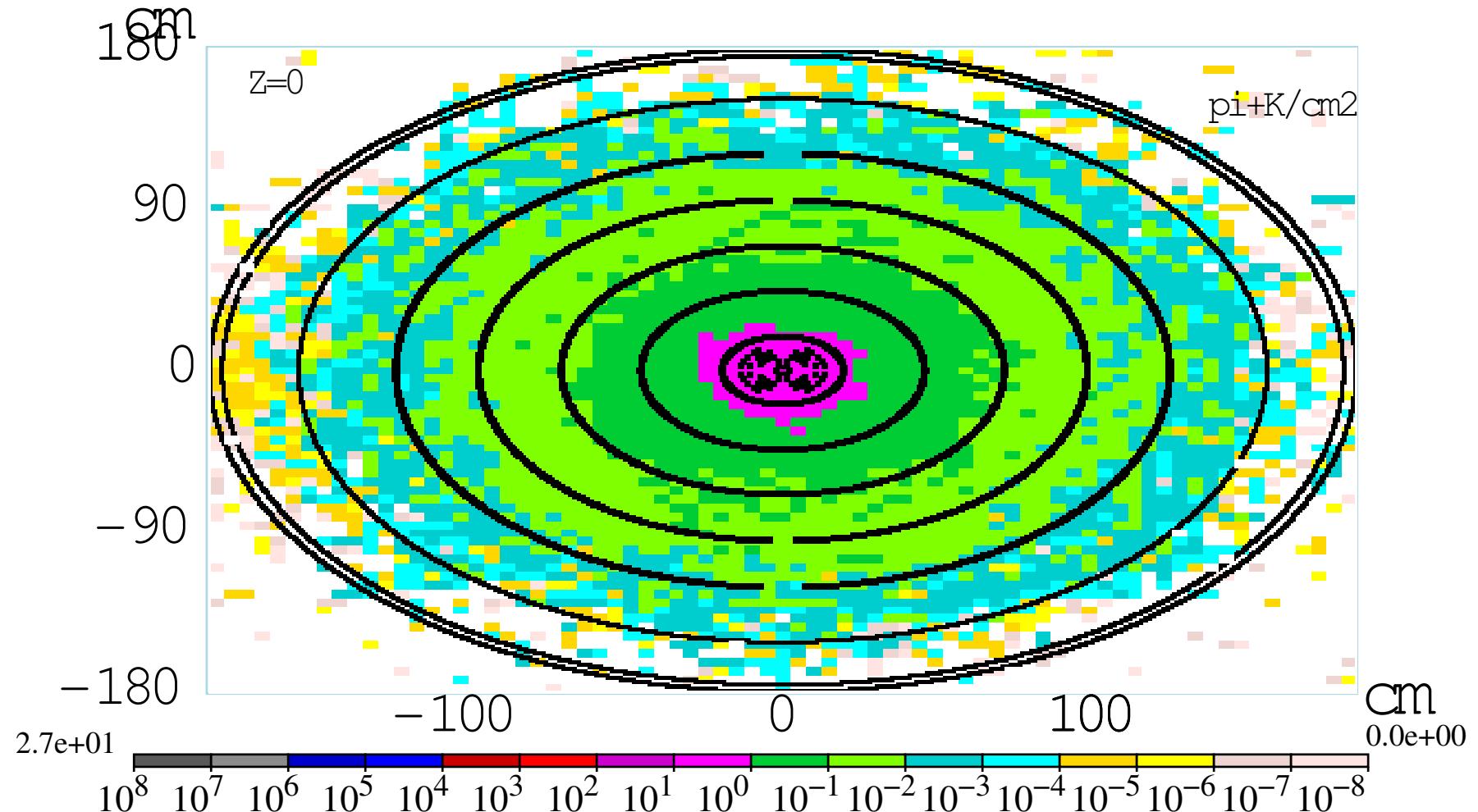
Electron fluence/cm²/bunch X-Y plane, Z = 750cm



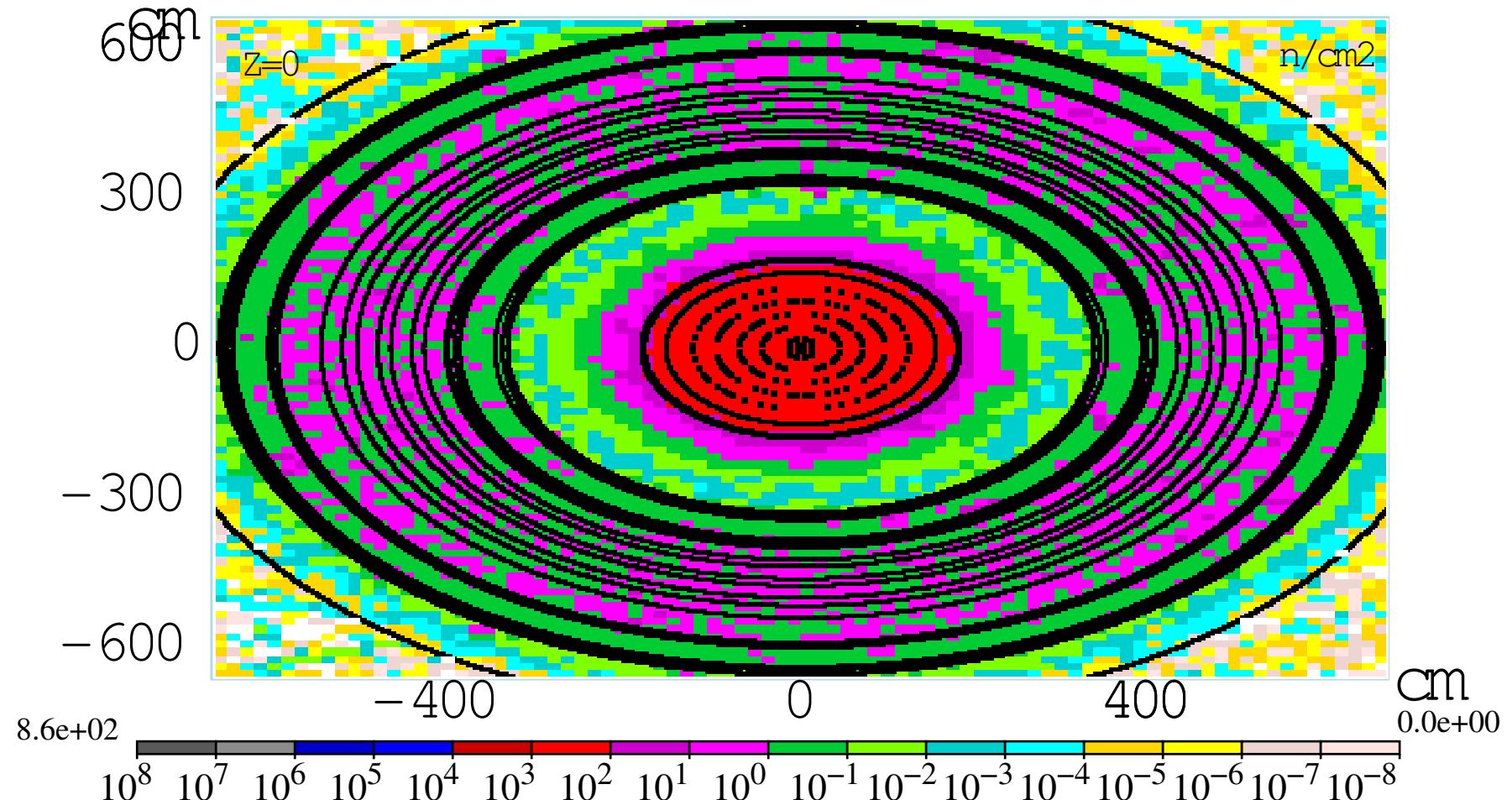
Proton fluence/cm²/bunch X-Y plane, Z = 0cm



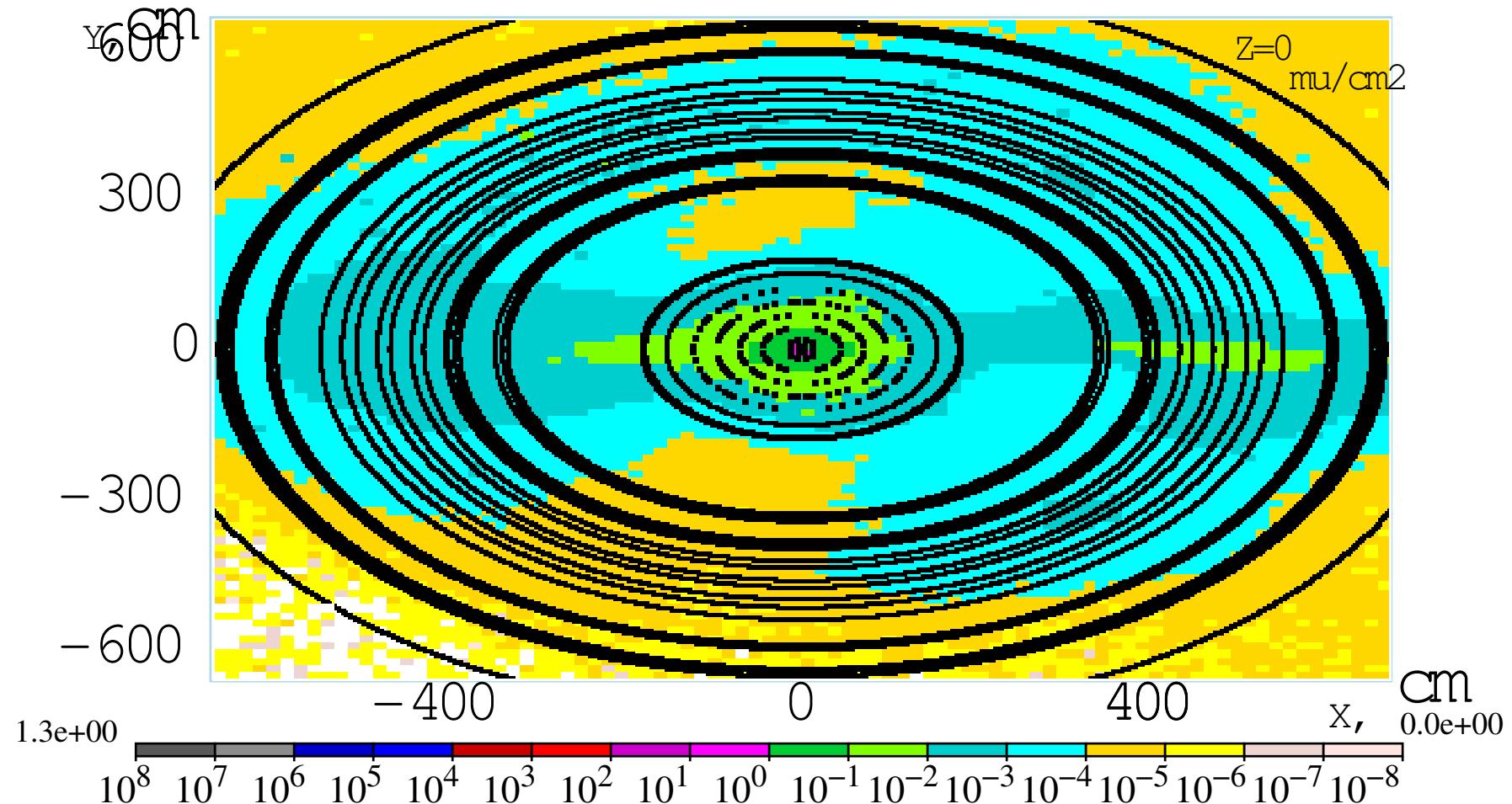
Pion and kaon fluence/cm²/bunch X-Y plane, Z = 0cm



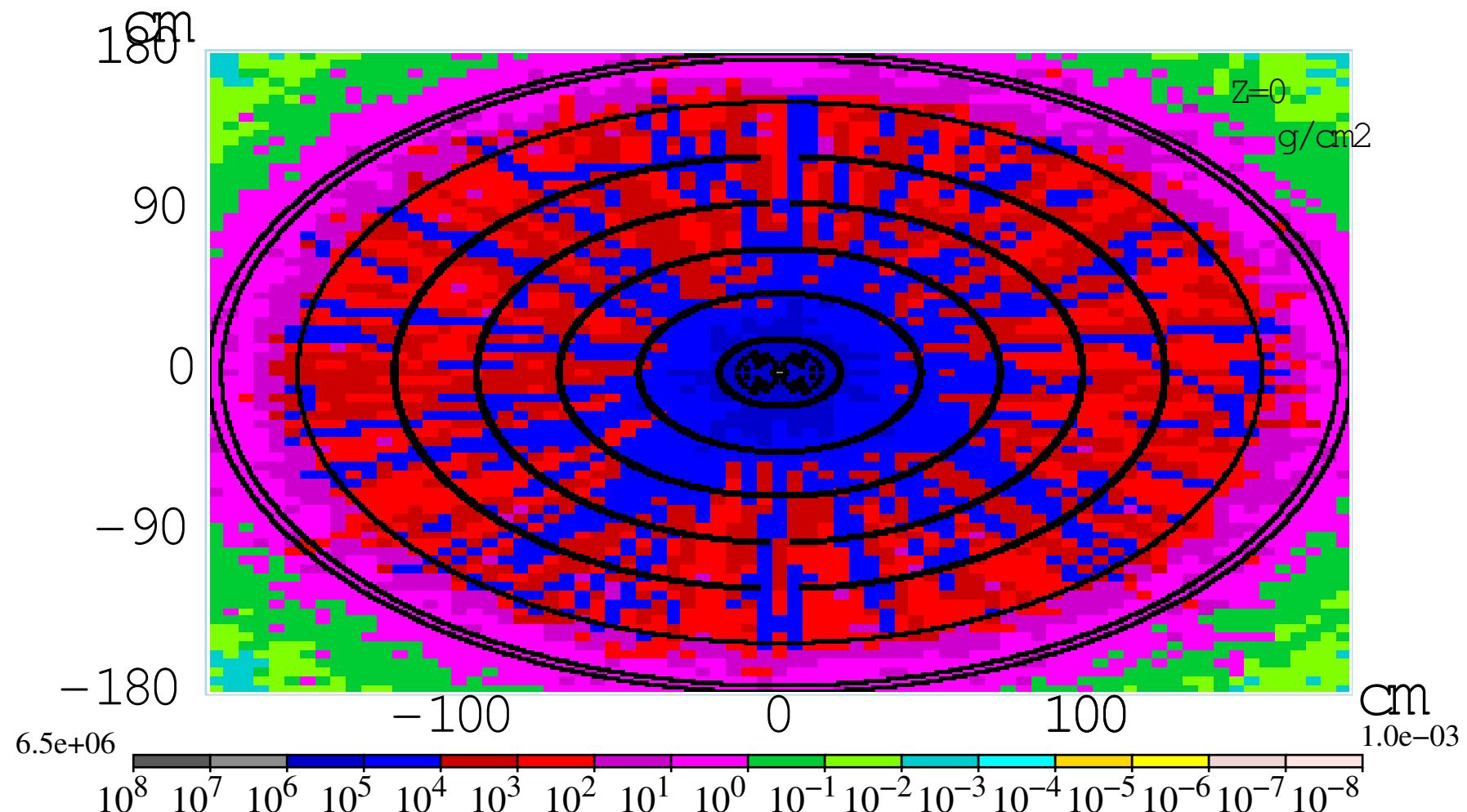
Neutron fluence/cm²/bunch X-Y plane, Z = 0cm



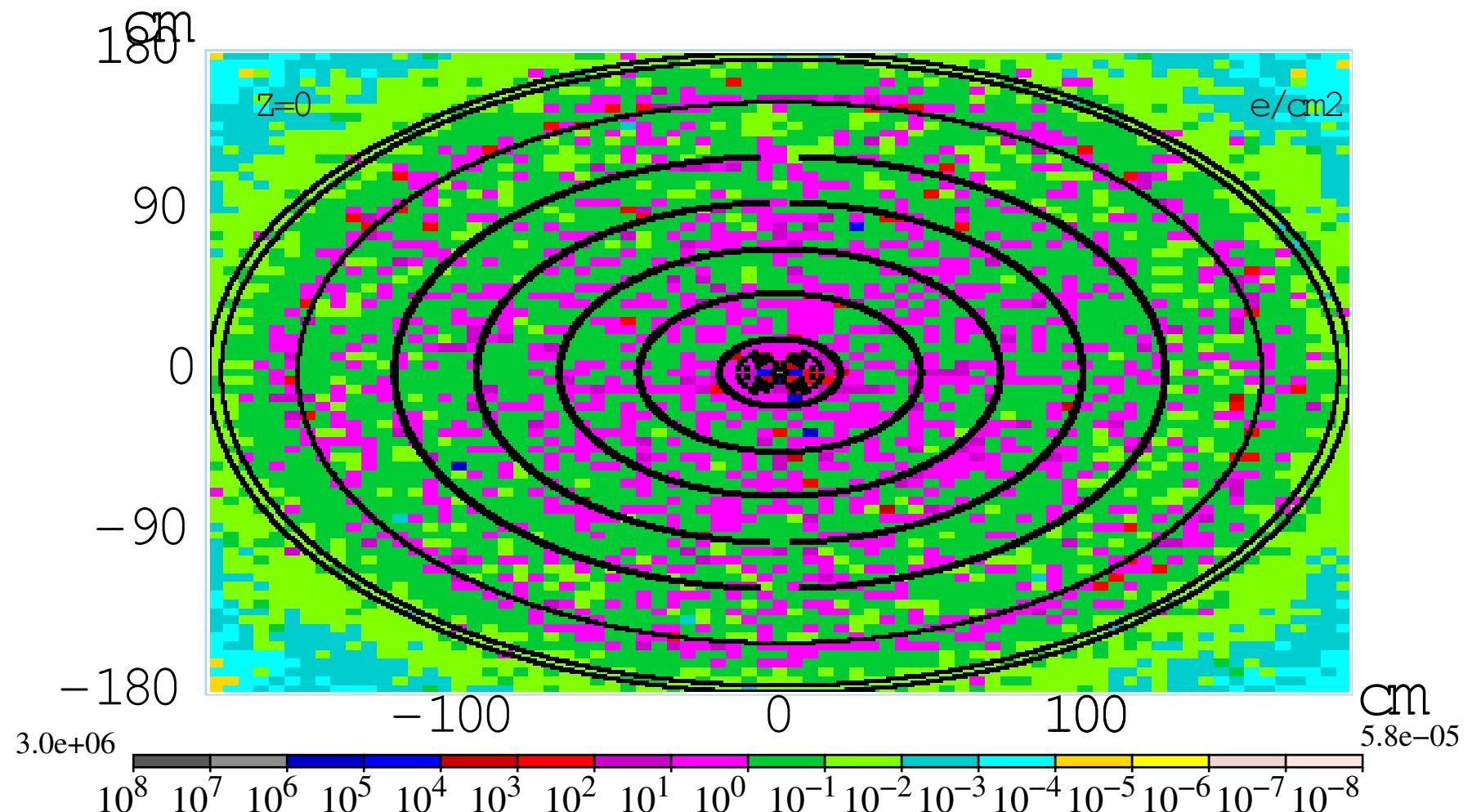
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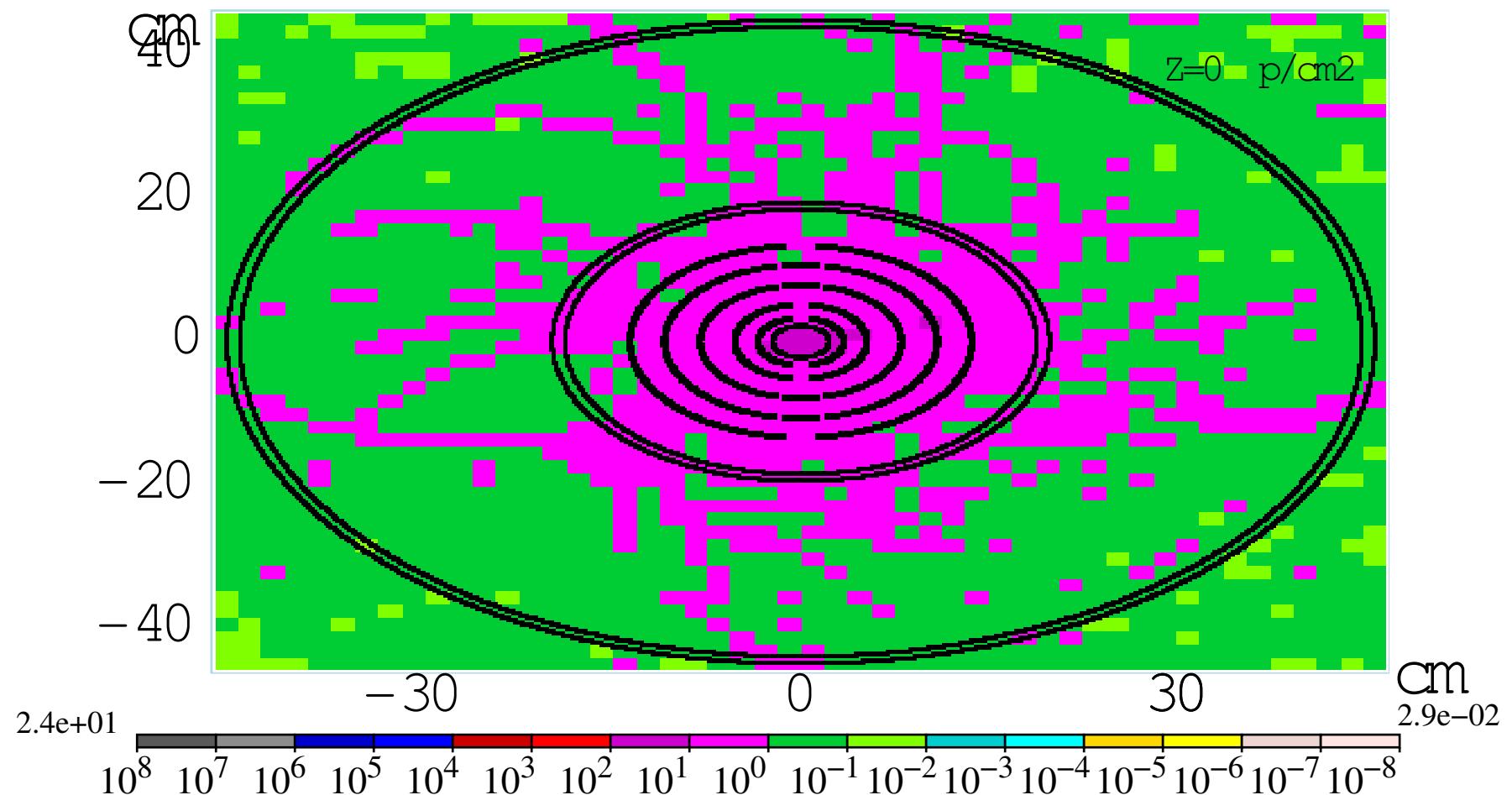
Gamma fluence/cm²/bunch X-Y plane, Z = 0cm



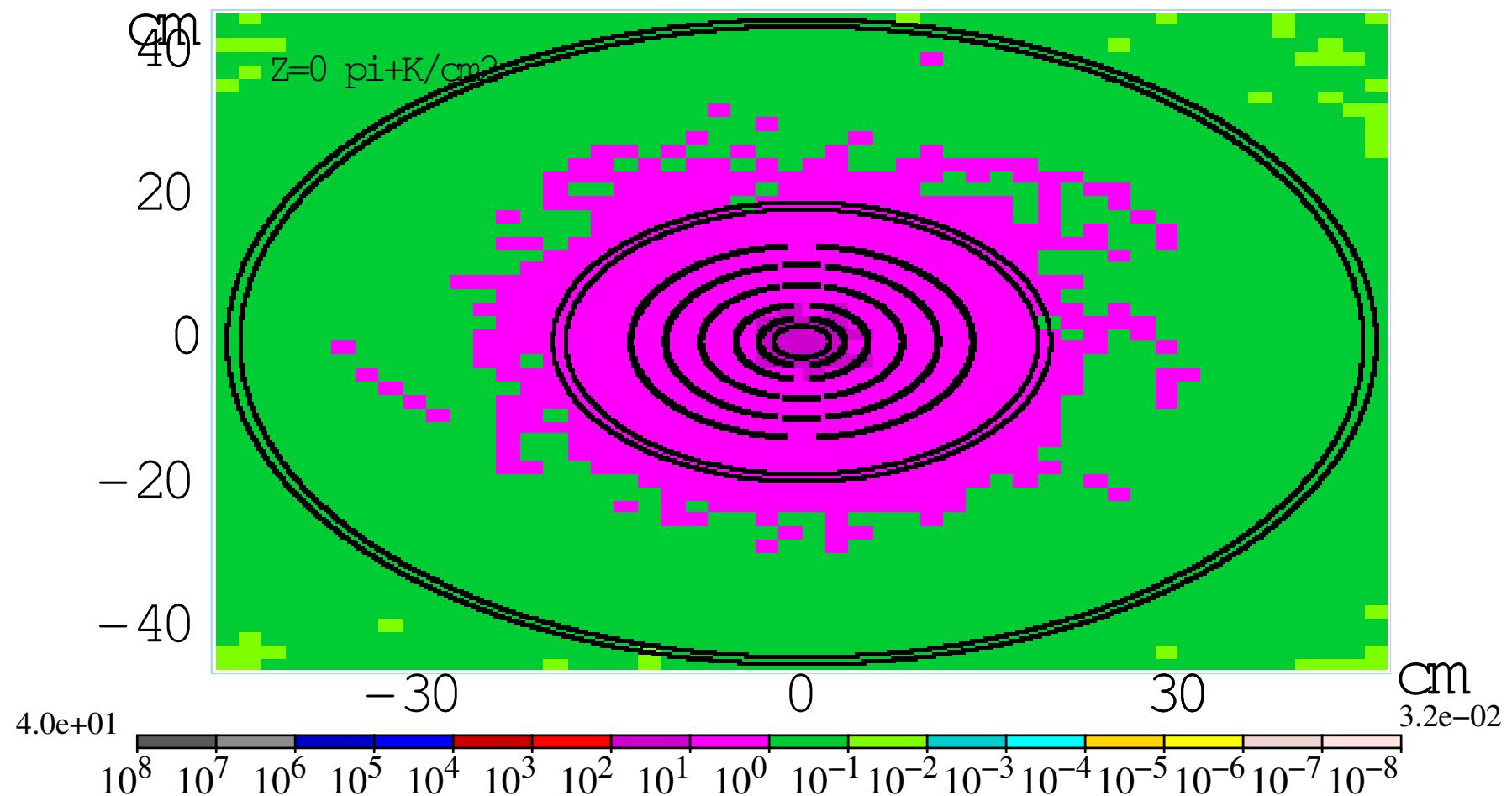
Electron fluence/cm²/bunch X-Y plane, Z = 0cm



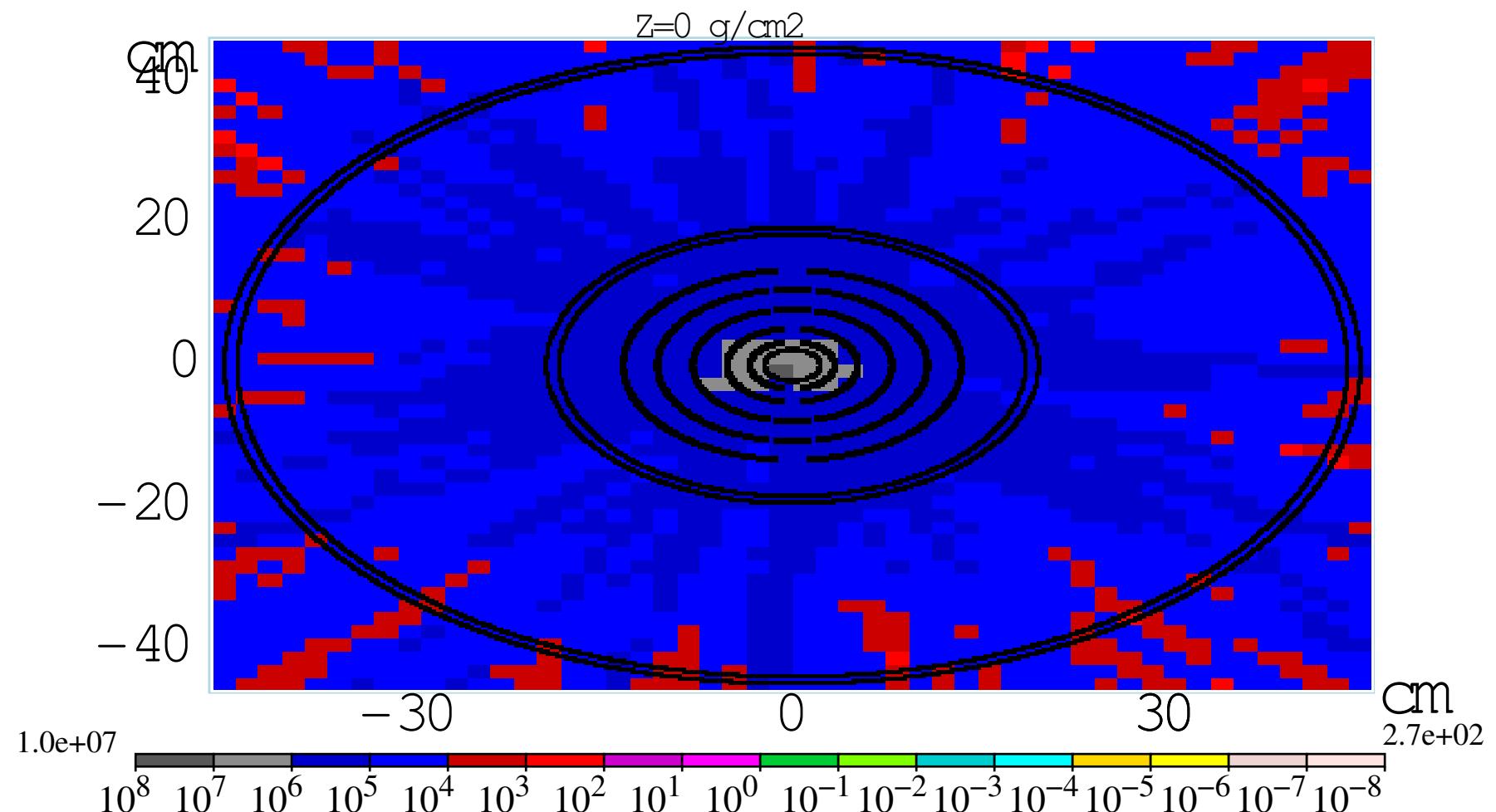
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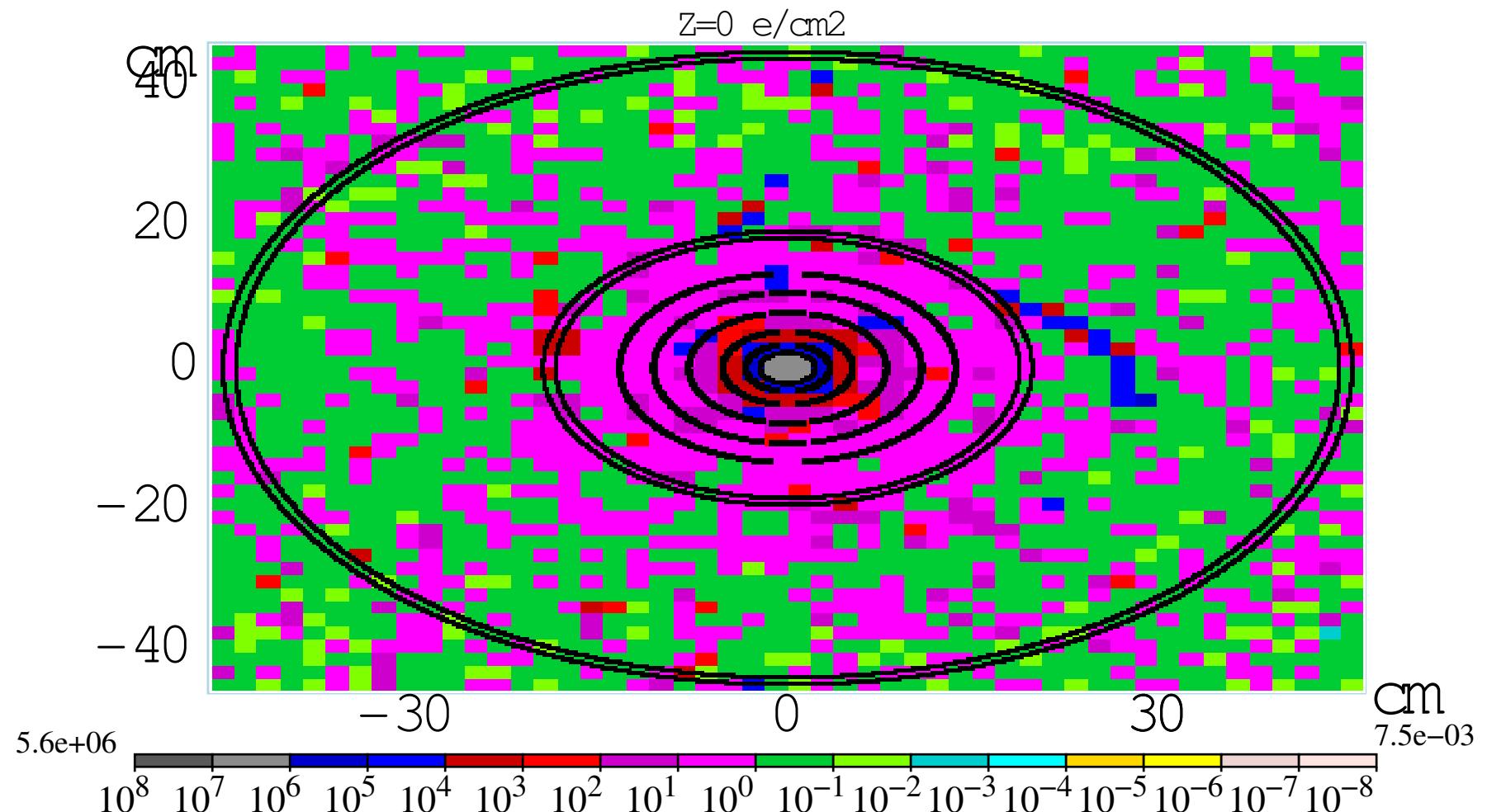
Pion and kaon fluence/cm²/bunch X-Y plane, Z = 0cm



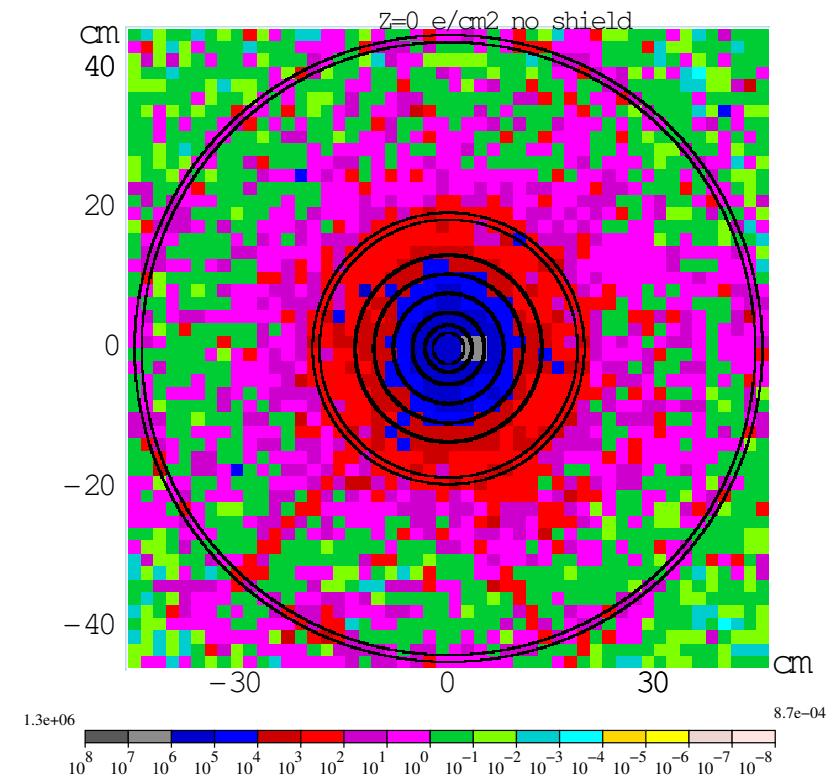
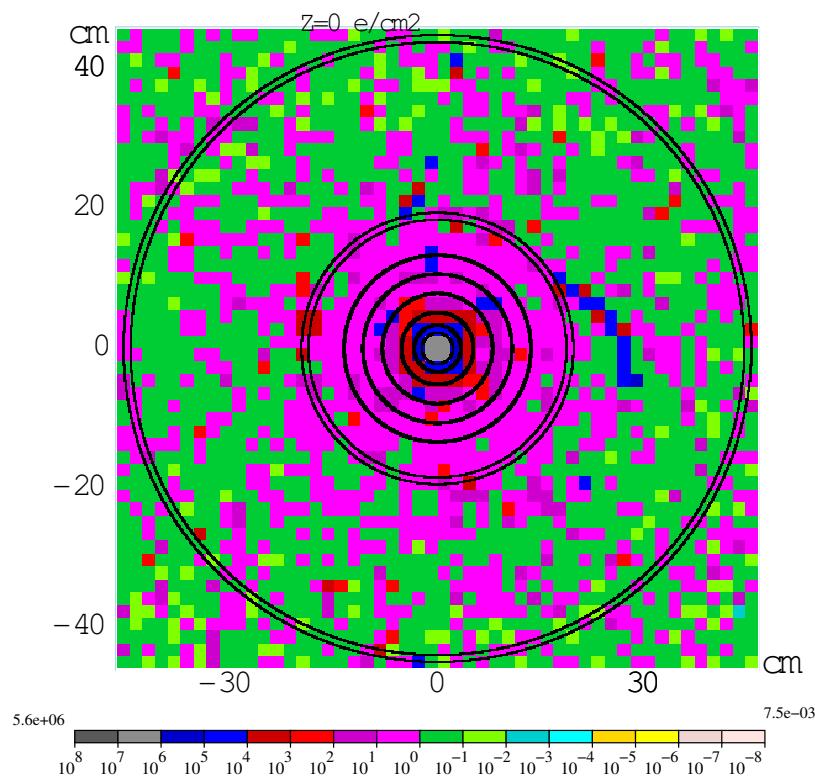
Gamma fluence/cm²/bunch X-Y plane, Z = 0cm



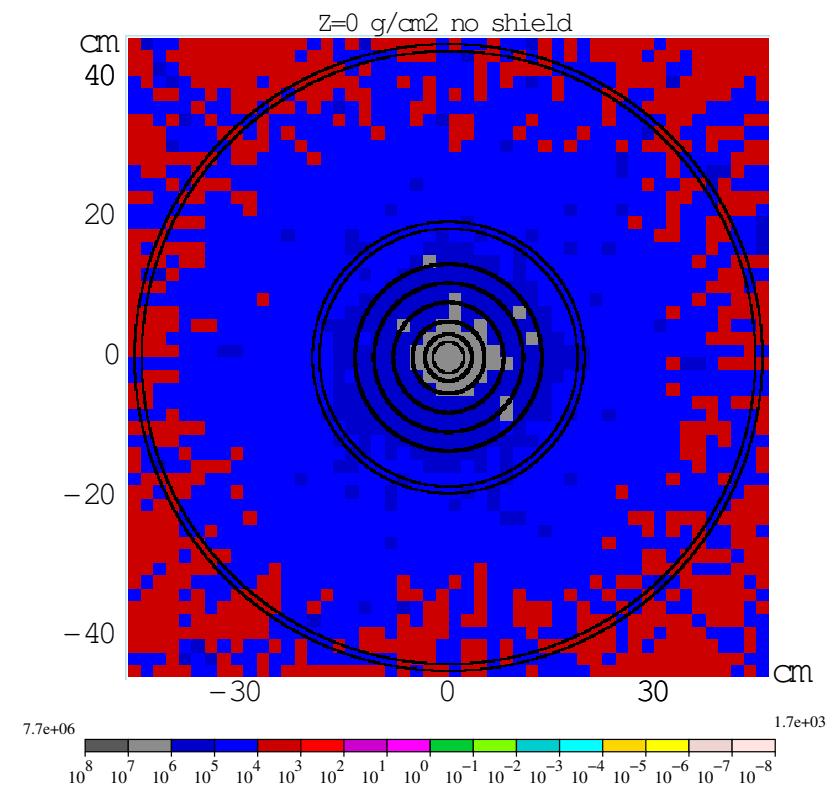
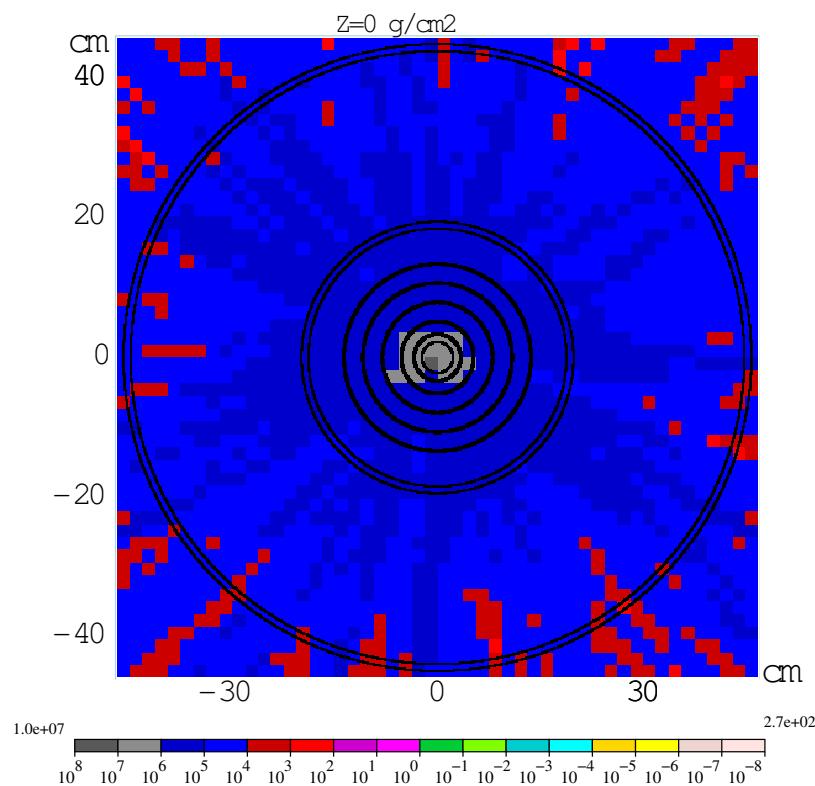
Electron fluence/cm²/bunch X-Y plane, Z = 0cm



Results with and w/o shielding, electrons



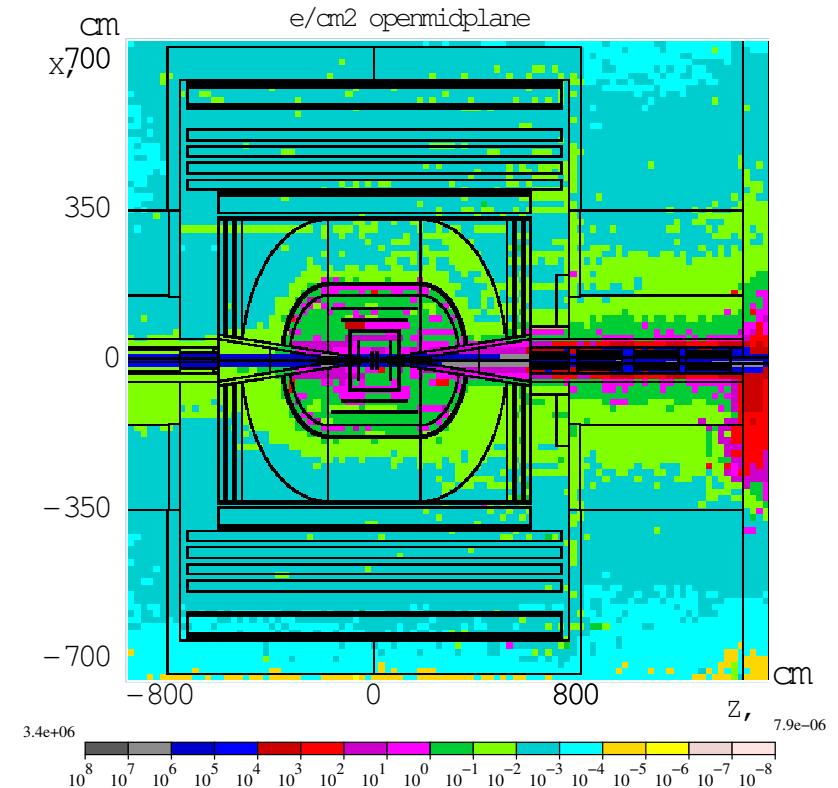
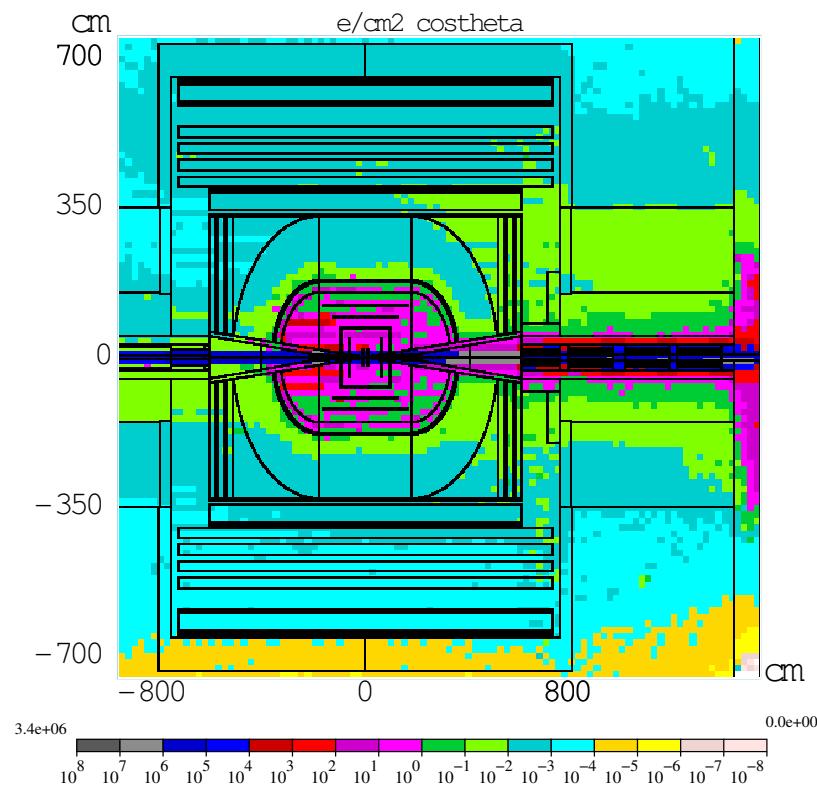
Results with and w/o shielding, gamma



Results for costheta and openmidplane dipoles

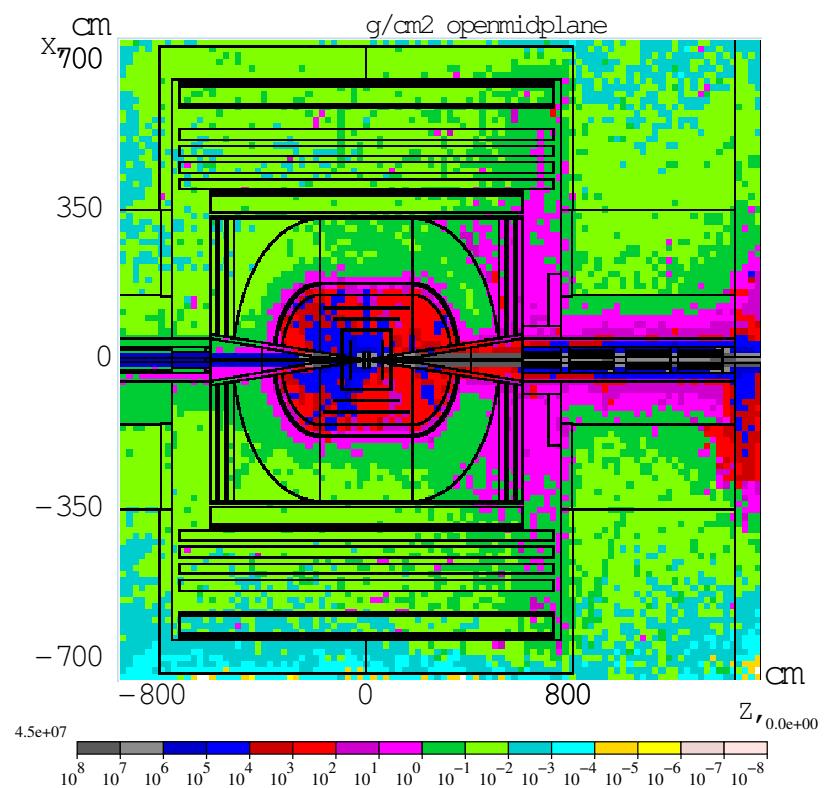
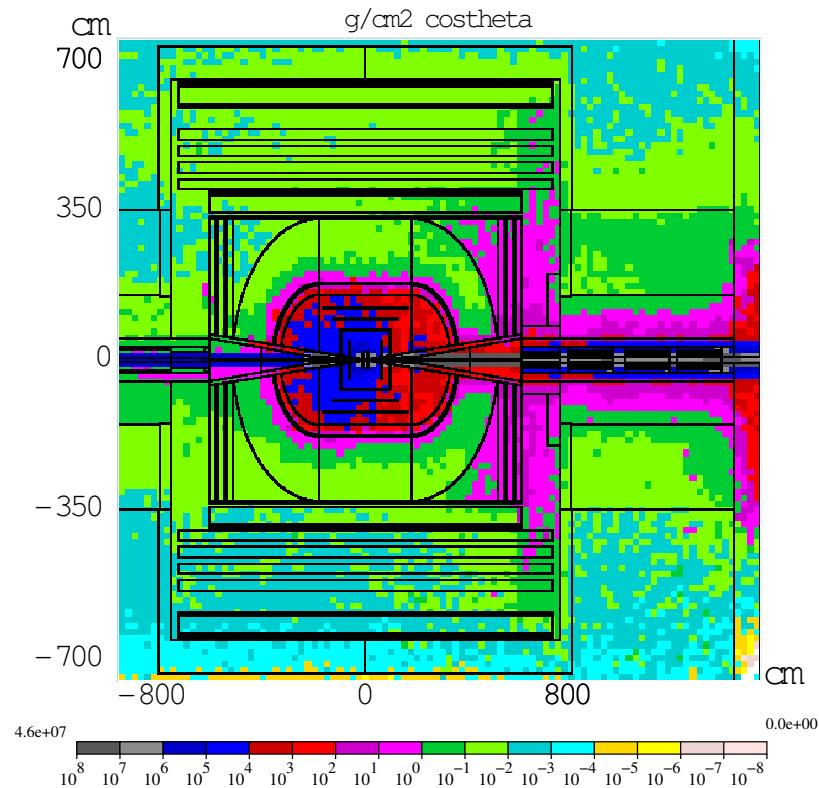
Openmidplane has 8cm opening, $6 * 10^3 cm^2$ yoke cs,
costheta $3.8 * 10^3 cm^2$ yoke cs.

Electrons.



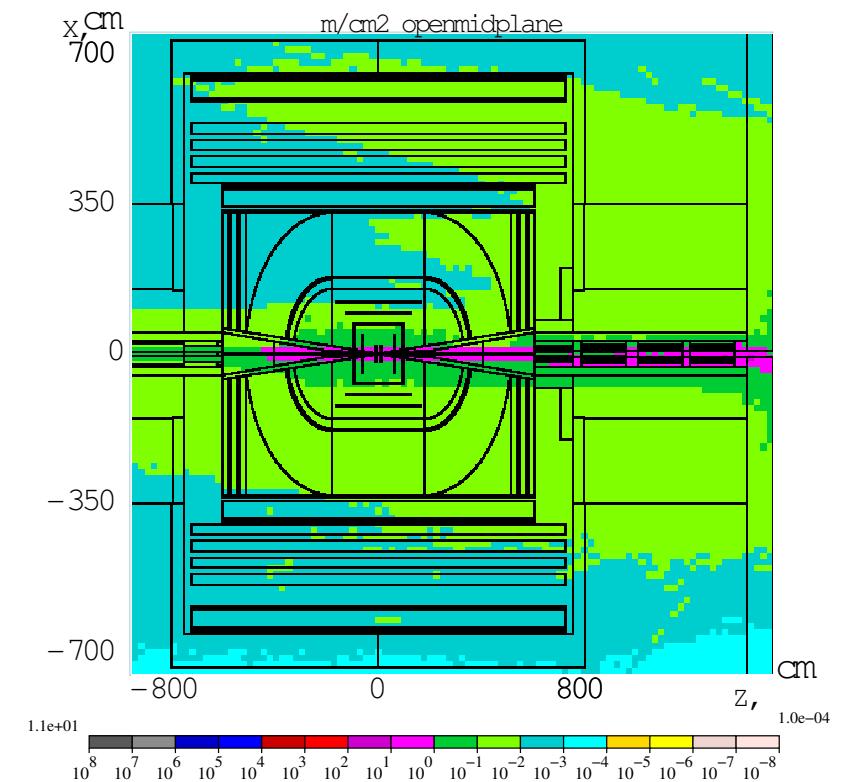
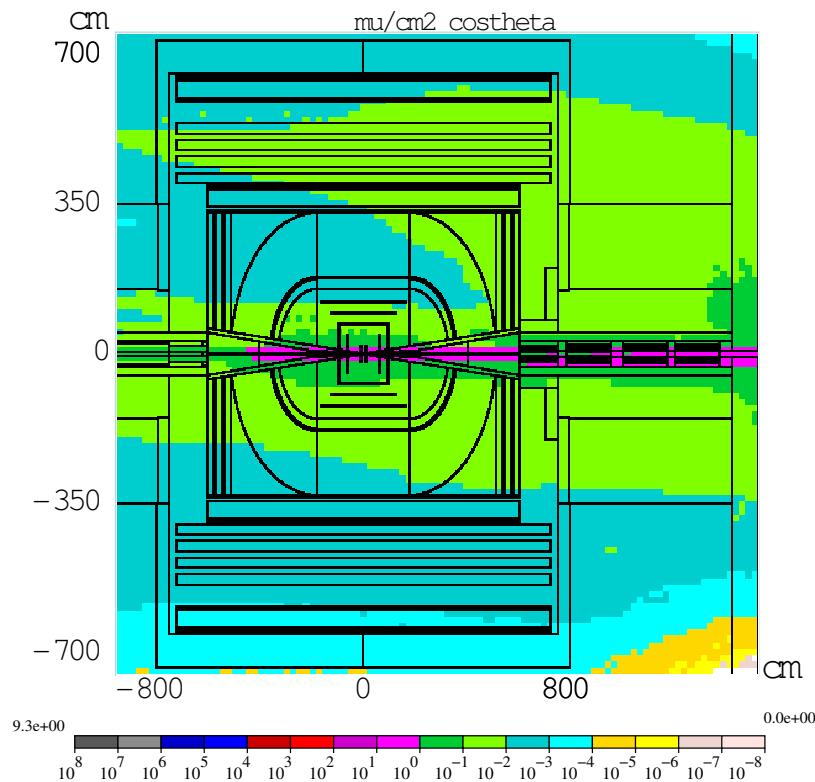
Results for costheta and openmidplane dipoles

Gamma.



Results for costheta and openmidplane dipoles

Muons.



Conclusion

- MARS15 beam line model of MC-750 was built, “4-th concept”-like detector incorporated
- First results on particle fluxes shown. No detailed analysis yet, but region $R < 5\text{cm}$ seems to be problematic (high gamma and electron fluxes).
- Better(and/or more) shielding options should be studied.
- Beam line model should be kept up-to-date with lattice and magnet design development.